A MANUAL OF

FORENSIC CHEMISTRY

DEALING ESPECIALLY WITH

CHEMICAL EVIDENCE,

ITS PREPARATION AND ADDUCTION.

BASED UPON

A COURSE OF LECTURES

DELIVERED AT

UNIVERSITY COLLEGE, UNIVERSITY OF LONDON.

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LONDON:
STEVENS AND HAYNES,
LAW PUBLISHERS,
BELL YARD, TEMPLE BAR

1909.

PREFACE.

In response to an invitation from the Governing Authorities of University College, London, the Author recently delivered a course of lectures on "Forensic Chemistry" at that institution. With so extensive a subject, it was necessary to select some particular branch for attention; and accordingly these lectures dealt especially with "Chemical Evidence, its preparation and adduction." Knowing something of the difficulties which beset both chemist and lawyer in this direction, the lecturer's aim was to afford the members of each of the two professions such information as to their mutual methods and requirements as a long experience had suggested to him would be of service.

The Author has received a number of requests from both lawyers and chemists to publish these lectures in book form, and as a

result the present volume now appears. Its style and arrangement closely follow those of the original lectures; but in order to make the treatment of the subject as complete as possible, a large amount of additional matter has been included. It is hoped that the book may prove of value and assistance to those who have to prepare and handle chemical evidence, embodying as it does the most important judicial decisions on this subject.

A Table of Cases is included in the Index.

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September, 1909.

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CHAPTER I.

INTRODUCTORY MATTERS.

Nature of Chemistry.—There is an almost endless diversity among the various objects by which mankind is surrounded; but one property, at least, they possess in common, and that is the property of *weight*. All objects are attracted by the earth, and the reason why a thing is heavy is that this earth-attraction, known as gravitation, offers the resistance called weight to any efforts to raise things from its surface. This property of weight characterizes not only solid substances like iron or wood, but likewise liquids, such as water and oil, and also gases, of which atmospheric air is an example. It is convenient to have one name that shall include all such bodies, and for this purpose the term *matter* is employed. Matter, then, is anything which possesses weight, *i.e.* is acted on by gravitation.

It is now easy to explain the objects of chemistry. Matter is not only most varied in form, but its form is also continually varying; it is the function of the chemist to investigate these different forms of matter, and also the changes to which they are subject. These

may be summed up in the following definition:—Chemistry is that science which treats of the composition of matter, of the changes produced therein by heat and other natural forces, and of the action and reaction of different kinds of matter on each other.

The composition of matter embraces all questions of analysis.

The action of forces on matter, and of different kinds of matter on each other, include the science of chemical processes and manufactures.

The study of the nature and action of drugs is expressly included in the domain of chemistry. The Institute of Chemistry is the governing body of the chemical profession; and, among its other functions, is an examining body. As such it examines chemists in Therapeutics and Pharmacology. These subjects include—"Uses of the commoner drugs . . . how far the impurities affect the medicinal value of the drugs; the chemical changes which familiar drugs may undergo in the body . . . the reputed medicinal, deleterious, and average fatal doses of such drugs as are poisonous; and the reputed effects of age, idiosyncrasy, and habituation in modifying these."

Forensic Chemistry.—The qualifying word "forensic" implies that which appertains to the proceedings of Courts of Justice. Forensic chemistry may therefore be regarded as including all those branches of chemistry which are of service in solving the various questions that arise during the course of judicial proceedings.

Thus in the administration of the Food and Drugs Acts their whole operation depends on the results of analysis. The same remark applies with almost equal force to many criminal actions, of which murder by poison is the most striking example. In civil cases too, chemistry often plays an important part; and in such litigation as that involved in patent actions, the chemistry of manufacturing processes is examined most exhaustively. A complete treatise on forensic chemistry would therefore have at least to deal with all the general principles of chemistry, all analytical methods, and all processes of chemical manufactures, *in so far* as they apply to the solution of judicial problems. It is scarcely too much to say that it would in fact require to be co-extensive with the science of chemistry itself. Such ambitious aims are not compatible with the scope of the present work, which, as already intimated, owes its origin to a course of lectures on forensic chemistry. Obviously, a small portion only of the subject could be treated within such limitations, and choice fell upon "chemical evidence, its preparation and adduction." The subject-matter of these lectures, with certain enlargements and additions, forms also the subject-matter of this book.

Nature of Evidence.—In all legal proceedings the first essential is that the facts of the matter in dispute shall be brought to the knowledge of the Court in the most authentic form possible. This is done by the giving of evidence, and evidence may be regarded as that by which facts are proved in the course of legal

proceedings. The Court is entitled to the very best evidence that can be obtained, and when it is available will usually insist on that of eye-witnesses, who are required to come personally to the Court and there state exactly what they have seen, or facts which are within their personal knowledge. The correctness of their evidence can then be tested by questions put on behalf of all the parties, and, should he deem it necessary, by the judge himself. Witnesses are frequently required to bring with them and produce books or other documents. They may also produce and show to the Court objects which serve to explain or elucidate their evidence.

In certain cases evidence may be given in writing, the document, according to circumstances, being then known either as a "statutory declaration" or an "affidavit." It is specially enacted by the Food and Drugs Acts that a certificate of analysis given by a Public Analyst may be produced in Court and used as evidence.

Burden of Proof.—It is the duty of the party who alleges the affirmative case to prove that case. Such party is generally the prosecutor or plaintiff. Thus, if milk is said to be adulterated, the prosecutor must prove the fact of adulteration. If the Crown accuses the prisoner in the dock of having poisoned a man, the Crown must prove that the man was in fact poisoned by the prisoner. At times the burden of proof shifts from one party to the other, and of this an illustration is afforded in the working of the Adulteration Acts.

The Board of Agriculture is empowered to make regulations determining what deficiency in any of the normal constituents of genuine milk, and other articles specified, shall raise a presumption, *until the contrary is proved,* that the milk is not genuine. On the prosecution proving such deficiency, the further burden of proof is on the accused person, who must show by sufficient evidence that the milk is in fact genuine.

It may be taken as an absolute rule that the evidence must be complete and conclusive. A very general defence is that the evidence is incomplete and inconclusive. Although this may at times seem to operate hardly against those on whom the burden of proof rests, yet a little consideration will show the rule to be a fair one. The defence has a perfect right to succeed if at any one point the chain of proof breaks.

Chemical Evidence.—Chemical evidence is that which deals with chemical *facts* and *deductions.* In general, such evidence is governed by the same rules as apply to other evidence. To this there is one important exception. The ordinary witness as to fact is not allowed to give his opinion. He may state that he saw the body of a man in a pool of water, but his opinion that some one must therefore have thrown him in is not evidence. But the expert witness, in which class is included the chemist, has a somewhat wider latitude permitted him. It was held in *Folkes v. Chad* (Cockle's Leading Cases on Evidence) as early as 1782 by MANSFIELD, C.J., that "In matters such as those of

science, expert witnesses may give evidence as to their opinion." The chemist may therefore state not merely his facts, but also the deductions he has drawn from them, and the opinions he has formed thereon.

Functions of Chemist and Lawyer.—Although both chemist and lawyer are concerned in the preparation and formulation of chemical evidence, they are not necessarily familiar with each other's methods and requirements. The chemist will often wish that he could get the lawyer to understand something at least of the processes by which he arrives at his results, so that the latter may realise more clearly the actual nature and value of the evidence he is prepared to give. The lawyer to whom a chemical report or certificate is sent will frequently regret that such a report contains much that is useless to him for his particular purpose, while perhaps something absolutely necessary in order to comply with a legal technicality is altogether wanting. It follows that the chemist should know sufficient of the rules of evidence to make his analyses or experiments as useful as possible to the lawyer. To the latter it is an immense advantage to be able to understand something of the principles underlying the processes by which the chemist arrives at his conclusions. The author's primary object in this work is therefore to make clear to both chemists and lawyers matters which are common ground to both professions, and to render them sufficiently plain for the members of each to understand, where they overlap, the work of

the other. Taking these in their natural sequence, the principles of chemical work and analysis will first demand consideration.

Chemical Analysis, Definition of.—For the present purpose this may be regarded as including all methods of ascertaining and determining the composition in whole or in part of the substance in issue.

IMPORTANT CONSIDERATIONS IN SUCH ANALYSIS.

I. Collection of Fair Samples.—The taking of samples is in itself a matter requiring much care, and frequently presenting considerable difficulty. Thus the contents of a vessel may vary in composition according to the part from which taken. For example, one part of a barrel of butter may contain a larger proportion of water than another. Or in a parcel of ore some pieces may be much richer in metal than are others. In all these cases the sample should be so taken as to represent as nearly as possible the average quality of the whole bulk. The chemist should himself take the sample; or some other person, skilled in the art of sampling the particular product, should take it for the purpose of analysis. The analyst will personally see to it that his sample is uniformly mixed before he takes portions for his analysis.

In certain bodies there is always a natural tendency toward separation. A good example of these is milk: the fat or cream is lighter than the remainder of the milk, and so rises to the surface. This is remedied by

thoroughly shaking or stirring before taking the sample. In case the sample is obtained by the ordinary method of purchase, the responsibility for its quality rests on the vendor. He cannot shield himself by proving that the bulk is much richer than was the actual lot sold. But the buyer, before dividing his purchase into parts, should take care that each part is of the same composition.

The point of separation of a sample was raised in a recent case, *Tucker v. Hayes and Finch*, 1908. In that case a sample was taken of a cake of candle-wax, and submitted to analysis. In cross-examination, the chemist, Hehner, was asked whether certain of the constituents might not, during the solidification of the melted mass, have first separated out and fallen to the bottom, thus causing the upper layer to be of different composition from the lower. In reply, the analyst was able to say that from the nature of the constituents no such separation could occur.

II. Changes in Sample.—In the case of perishable articles considerable changes may take place in the substances after the purchase and before the sample has reached the analyst. Thus milk may go sour, and in extreme cases may lose some portion of its solid matter by its conversion into gases as a result of fermentation. This property is recognised by the Food and Drugs Acts, and in the case of a certificate regarding milk, butter, or any article liable to decomposition, the analyst is required to specially report

whether any change had taken place in the constitution of the article that would interfere with the analysis. (See "Form of Certificate," Chapter VIII.)

The excise laws permit the sale of non-intoxicating beers, as for example ginger beer and the so-called herb beers, free of duty, provided the amount of alcohol they contain does not exceed 2 per cent. of proof spirit. These non-excisable beers are prepared by a process of fermentation in which sugar is changed by yeast into alcohol and carbon dioxide gas, just the same as in ordinary beers. In order to prevent the alcohol exceeding the excise limit, the quantity of sugar must be carefully regulated and the fermentation arrested when sufficient alcohol has been produced. The resultant beer has usually some unchanged sugar left in it as a flavouring matter. If the beer has simply been sterilised, and untreated with a preservative, the accidental introduction of some fresh yeast may again set up fermentation, and thus increase the percentage of alcohol present to an amount beyond the permitted limit. From time to time the excise authorities purchase samples of non-excisable beers and submit them to analysis. In the case of excess of alcohol, a possible line of defence is that fermentation has occurred during the period between purchase and analysis, and consequently the excess at the latter date is not conclusive proof of excess of alcohol at the time of sale. Under such circumstances an analyst, if pressed, would probably admit that such a change was possible though exceedingly improbable. In

anticipation of such defence, the analyst should observe carefully the condition of the sample when submitted to him—*i.e.*, whether quiescent or in a state of fermentation. If considered necessary, the beer may be examined for living yeast cells, and also for the presence or absence of sufficiency of preservative to inhibit fermentation. Positive evidence may thus be obtained which will negative the defence of after-fermentation if raised. On the other hand, such defence may be considerably strengthened by showing that other bottles of the same batch (as well as a portion of the sample taken for analysis) were in active fermentation, or in such a condition that, on opening, active fermentation was promptly set up.

III. Methods of Analysis, Principles of.—The methods of analysis may be conveniently divided into two groups, namely, those of *Direct* and *Indirect* methods.

Direct Methods.

(1) Separation, recovery, and determination of the essential constituent. For example, fat from milk, or arsenic from a body suspected of being poisonous.

(2) Separation, recovery, and determination of some body which is a *measure* of the essential constituent. For example, butter fat contains certain volatile acids. The separation and estimation of these afford a measure of the quantity of butter fat in a mixture of fats.

(3) Production, separation, recovery, and determination of some body containing a definite proportion of

the essential constituent, or some component of the essential constituent. For example, from a substance containing potassium phosphate, magnesium phosphate may be obtained by precipitation and determined. Magnesium phosphate contains a definite proportion of anhydrous phosphoric acid, or phosphoric anhydride, and so the amount of that body in the original substance is ascertained.

Indirect Methods.

(1) Determination of physical characteristics. For example, specific gravity. Thus water has a specific gravity of 1·0000, and pure alcohol of 0·7935. Mixtures of water and alcohol have intermediate specific gravities, and as all potable spirits are mixtures of alcohol and water the determination of the specific gravity affords a means of ascertaining the proportions of alcohol and water present. It is obvious that for such methods to be trustworthy there must be no other disturbing body in the substance. In the case of ordinary spirits, such as whisky or gin, there are only traces of bodies other other than alcohol and water present, and these do not materially interfere with the results. With beers it is different, and so all the spirit and some of the water are first separated by distillation, and then the specific gravity of the distilled portion (distillate) is taken. From this, the percentage of alcohol in the beer is obtained by calculation. If wished for the sake of greater accuracy, spirits such as gin or whisky may similarly be first distilled.

Another such mode of analysis is the determination of the molecular weight of a substance. The chemist terms the smallest possible particle of a body, which is capable of existing alone, a molecule; and the relative weight of this is termed the molecular weight. Such molecular weight may be ascertained by chemical analysis. Suppose a substance is known to consist of a mixture of two bodies only, one of which has a molecular weight of 100, and the other of 200; and that the mixed substance has a molecular weight of 150. Obviously, the mixture must consist of equal quantities of each constituent. With any other intermediate molecular weight, the proportions of each constituent is simply a matter of calculation. This mode of analysis was largely employed in the analyses of candle waxes for the purposes of the case of *Tucker v. Hayes and Finch* before referred to.

(2) Determination of some chemical effect which the essential constituent is capable of producing. For example, an alkali possesses the power of neutralising an acid. If a solution of acid of known strength is prepared, the amount of alkali in a substance under examination may be ascertained by determining the quantity of the acid solution it is capable of neutralising. Conversely, the quantity of acid in a substance may be determined by the similar employment of a solution of alkali of known strength. The chemist prepares a range of such solutions, known as standard or normal alkalis and acids, and uses them for analytical operations of this description. Such determinations are known

respectively as alkalimetry and acidimetry. The whole branch of analysis, termed volumetric analysis, is based on the estimation of bodies by the use of standard solutions of known strength and which produce specific and recognisable chemical changes.

As another example, certain sugars possess the property of precipating in the insoluble form an oxide of copper, known as cuprous oxide, from a solution of copper salts. If, with the requisite precautions, a solution of a sugar be added to the copper salt solution, this precipitate is formed and may be separated and weighed. The amount of the cuprous oxide thus obtained is a measure of the quantity of the sugar present in the body under examination. This constitutes the well-known Fehling's Test.

Although the details of methods of chemical analysis are to the lay mind most complicated and involved, there is scarcely an operation of analysis which does not fall either into one or other of the groups described, or is a combination of two or more of them.

Minute Traces.—Occasionally a question is raised as to the recognition of minute traces. Thus, in some forms of analysis a return is made of the number of parts per million of some constituent. An objection may be taken that accuracy in the determination of such infinitesimal quantities is impossible, and that, even if determined, it cannot possibly matter whether so small a quantity of any particular substance is present or absent. The first objection can only succeed

when those responsible for the decision are totally ignorant of the principles of analysis. Parts per million are by no means difficultly recognisable and determinable by analytic methods; and a chemist may speak with just as much certainty of these apparently minute quantities as he would of the number of lbs. of a body in a cwt. of a mixture. The latter objection is perhaps more plausible, but equally fallacious. Brandy should consist entirely of spirit distilled from wine, which in turn ought only to consist of the fermented juice of the grape. Brandy is imitated by taking plain alcohol, colouring and flavouring it to look and taste something like the genuine spirit. In making an analysis, the chemist searches for and estimates some special constituent, which in genuine brandy is present in only the most minute quantities, while in the fictitious spirit it is entirely absent. It may be very likely that the trace of this body present in the brandy does not materially affect its quality, and if it could be removed without any other disturbance, the spirit would not be appreciably altered. This, however, is not the point; the analyst determines this body because it is evidence of whether the liquid is brandy or not. If present in the normal quantity, it goes to prove the spirit is genuine; a diminished amount tends to show plain spirit has been added. If the amount diminishes to vanishing point, the conclusion is that the spirit contains no brandy at all. It is in this way that determinations of constituents, comparatively unim-

portant in themselves, may nevertheless be pregnant with information as to the purity or otherwise of a body.

Blank Experiments.—Frequently there are unavoidable impurities in the chemical reagents used in an analysis; or there may be errors of experiment that should be considered and allowed for. A common method of providing for these is by means of what is called a "blank experiment." For example, in what is known as Kjeldahl's method of determining nitrogen in organic bodies, the weighed quantity of the substance is heated in a flask with sulphuric acid and other reagents until completely decomposed. The nitrogen is then present in the form of ammonium sulphate; from this it is liberated by the addition of sodium hydrate, and ammonia is distilled off, and estimated. The quantity of ammonia thus found is the measure of the nitrogen in the original body. It is almost impossible to get the various reagents free from traces of ammonia. The usual practice is therefore to make an experiment exactly like the whole determination, except that none of the body to be estimated is used. The sulphuric acid and other reagents are heated in the flask, and every stage of the process gone through. At the end, the distilled ammonia is determined. The quantity should not be large; but in practice there is always some obtained. Whatever the amount may be, this is used as a correction, and is deducted from that found

in the actual analyses. Such a blank experiment should be made with each fresh lot of reagents.

But where such blank analyses are made, it must be remembered that they are "unreliable unless all the circumstances be thoroughly comprehended and taken into account." For example, in *Crooke's Select Methods of Analysis*, directions are given for the testing of reagents for arsenic by a blank analysis. On thus testing ferric chloride it gave no arsenic reaction, and was apparently pure; nevertheless arsenic in considerable quantities was evolved in the course of an experiment in which this ferric chloride was used. On subsequently repeating the blank test on the ferric chloride, but with the addition of copper or carbon (charcoal), a considerable amount of arsenic was evolved. The explanation is that the arsenic in the ferric chloride had to be reduced to the arsenious form before it would distil off in the test. (*Analyst* XV. 16.)

When blank analyses are relied on, they should be carefully studied from this standpoint, both by the side submitting the result and by those whose duty it is to question and, if necessary, attack them.

Such underlying principles as are here described, if once grasped by the legal mind, should prove of immense assistance in the understanding and digesting of analytic evidence.

Range of Chemical Evidence.—As already stated, such evidence is required in a wide range of cases,

such as those arising out of the Food and Drugs Acts, more important criminal matters, and many civil causes. It is proposed to illustrate its utilisation by reference to cases occurring in the administration of these various branches of the law.

CHAPTER II.

ADULTERATION OF FOOD.

Food and Drugs Acts.—The principal Act passed for the purpose of ensuring the purity of Food and Drugs is that entitled "The Sale of Food and Drugs Act, 1875." There is also an amending Act, entitled "The Sale of Food and Drugs Act, 1899," in which certain important alterations are made. Food and Drugs are defined in the following words in section 2 of the 1875 Act:—

> "The term 'food' shall include every article used for food or drink by man, other than drugs or water.
>
> "The term 'drug' shall include medicine for internal or external use."

In the Act of 1875, sections 3 to 9 deal with the description of offences under the Act. Sections 3 and 4 prohibit the mixing of injurious ingredients with articles of food and drugs, and also prohibit the selling of same. The following important sections are set out in full:—

Prohibition of the sale of articles of food and of drugs not of the proper nature, substance, and quality.

"6. No person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality of the article demanded by such purchaser, under a penalty not exceeding twenty pounds; provided that an offence shall not be deemed to be committed under this section in the following cases; that is to say,

(1.) Where any matter or ingredient not injurious to health has been added to the food or drug because the same is required for the production or preparation thereof as an article of commerce, in a state fit for carriage or consumption and not fraudulently to increase the bulk, weight, or measure of the food or drug, or conceal the inferior quality thereof;

(2.) Where the drug or food is a proprietary medicine, or is the subject of a patent in force, and is supplied in the state required by the specification of the patent;

(3.) Where the food or drug is compounded as in this Act mentioned;

(4.) Where the food or drug is unavoidably mixed with some extraneous matter in the process of collection or preparation."

Provision for the sale of compounded articles of food and compounded drugs.

> "7. No person shall sell any compound article of food or compounded drug which is not composed of ingredients in accordance with the demand of the purchaser, under a penalty not exceeding twenty pounds."

Prohibition of the abstraction of any part of an article of food before sale, and selling without notice.

> "9. No person shall, with the intent that the same may be sold in its altered state without notice, abstract from an article of food any part of it so as to affect injuriously its quality, substance, or nature, and no person shall sell any article so altered without making disclosure of the alteration, under a penalty in each case not exceeding twenty pounds."

Section 5 affords protection to persons in certain cases on proof of absence of knowledge on their part. Section 8 makes an exemption in favour of vendors who affix to their goods a label distinctly setting out that the food or drug is mixed.

In the case of *James v. Jones*, 1894, 1 Q.B. 304, it was *Held* that baking powder was not an article of food, and that the sale of it was not an offence within section 3, Food and Drugs Act, 1875. In

course of his judgment HAWKINS, J., said:—"We are clearly of opinion that the baking powder in question is not an article of food, and that neither the sale of it nor the admixture of it with an article of food, unless such article is intended for sale, is prohibited by the statute." No doubt, as a result of this decision, the definition of food is extended as follows in section 26 of the Act of 1899:—

"26. For the purposes of the Sale of Food and Drugs Acts the expression "food" shall include every article used for food or drink by man, other than drugs or water, and any article which ordinarily enters into or is used in the composition or preparation of human food; and shall also include flavouring matters and condiments."

This Act further in section 8 restricts the amount of butter fat in margarine:—

"8. It shall be unlawful to manufacture, sell, expose for sale, or import any margarine, the fat of which contains more than ten per cent. of butter fat; and every person who manufactures, sells, exposes for sale, or imports any margarine which contains more than that percentage, shall be guilty of an offence under the Margarine Act, 1887; and any defence which would be a defence under section seven of that Act shall be a defence under this section, and the provisions of the former section shall apply accordingly."

ILLUSTRATIVE EXAMPLES AND CASES.

The following examples indicate something of the general scope and operation of the Food and Drugs Acts. They have also been chosen so as to illustrate so far as possible points of interest which arise in the administration of these laws.

Milk.—Unless otherwise specified, by milk is understood that of the cow in its natural and unaltered state. Milk consists essentially of fatty matter, sugar of milk (lactose), proteids (casein, etc.), and mineral matters (ash), suspended or dissolved in water. The following table, based on the authority of Vieth and Richmond, gives the average composition of pure new milk:—

Fat, ...	...	4·0
Sugar, ...	4·5	
Proteids, ...	3·6	
Ash, ...	0·7	
Total non-fatty solids,	—	8·8
Water, ...	...	87·2
		100·0

From the analysis of a large number of samples, the following maximum and minimum percentages of fat, and solids not fat, have been found:—

	Fat, per cent.	Solids Not Fat, per cent.
Maximum, ...	12·52	10·60
Minimum, ...	1·04	4·90

Droop Richmond states that these samples were all undoubtedly genuine.

By the removal of fat, what is called "separated milk" is produced. In this the percentage of other solid bodies is slightly increased, and separated milk has about the following average composition:—

Fats, ...		0·3
Sugar, ...	4·6	
Proteids, ...	3·7	
Ash, ...	0·7	
Total non-fatty solids,	—	9·0
Water,...		90·7
		100·0

With a substance varying so widely in composition as does milk, it becomes necessary to fix certain standards or limits, below which a milk shall be regarded as adulterated. Fortunately, although the milk of individual cows may differ so largely, the mixed milk of a herd is much more constant in composition, and so a standard is the more readily fixed which shall not be unjust to the vendor, and yet shall protect the public from gross imposition. In the early days of its existence, the Society of Public Analysts resolved that milk should contain

"not less than 9·0 per cent. by weight of milk solids not fat, and not less than 2·5 per cent. of butter-fat." With improved methods of analysis, more fat was obtained from the same milk, and accordingly these figures were modified by the Society in 1886, which then resolved that in future milk should not be passed as genuine unless it contained:—"Total solids 11·5 per cent., consisting of not less than 3 per cent. of fat, thus leaving not less than 8·5 per cent. of non-fatty solids."

Allen is of the opinion, based on a very wide experience, that "the limits of 8·5 for non-fatty solids and 3·0 per cent. for fat are as low as is consistent with the interests of the public, and are not liable to occasion injustice to the milk vendor, provided they are applied with the discretion which a public analyst is presumed to possess." Vieth, in discussing this standard, has written:—"I think it is very judiciously fixed, but, in upholding the standard of purity, it should not be forgotten that the cows have never been asked for nor have given their assent to it, and that they will at times produce milk below standard. A bad season for hay-making is, in my experience, almost invariably followed by a particularly low depression in the quality of the milk towards the end of the winter. Should the winter be of unusual severity and length, the depression will be still more marked. Long spells of cold and wet, as well as of heat and drought, during the time when cows are kept on pasture, also unfavourably influ-

ence the quality and, I may add, quantity of milk." Droop Richmond regards the limit of 3·0 per cent. for fat as certainly reasonable for the mixed milk of a whole herd. But, in his view, "a milk should never be pronounced as watered on the evidence of the solids not fat alone, unless this is well below 8·0 per cent.; a determination of the total nitrogen and of the ash at least should be made in addition; a judgment formed on these determinations will be in all probability correct."

Instead of standards or limits, the adoption of a scheme of valuation of milks has been suggested on various occasions. Thus Estcourt in 1883 proposed to give marks to a milk on the results of analysis. His suggestion was that 8·5 per cent. of non-fatty solids should count as 200, and 3·0 per cent. of fat as 100. From these he deduced the factor 7·85 for non-fatty solids, and 11·10 for fat, and proposed that a milk which contained such a percentage of non-fatty solids and of fat as would, when multiplied by their respective factors, together produce 100, should be considered of full value, and consequently not liable to condemnation. Therefore a milk containing 8·5 of non-fatty solids and 3·0 per cent. of fat would have a value of 100, for

$$8{\cdot}5 \times 7{\cdot}85 = 66{\cdot}7 \text{ and}$$
$$3{\cdot}0 \times 11{\cdot}10 = 33{\cdot}3$$
$$\overline{100{\cdot}0}$$

The values given to the fats and non-fatty solids are arbitrary, and have evidently been selected so as to bring the awarded marks into line with the approval or condemnation of a milk by the Society of Public Analysts' standard.

There is another aspect of this question, and one which it may be well to consider in conjunction with the problem of milk adulteration. For commercial purposes, a direct estimate of value is of more importance than knowing whether or not a particular sample of milk passes the limits of the public analyst. Thus milks containing respectively 3 and 4 per cent. of fat would, so far as the fat is concerned, be passed as free from adulteration; but evidently the former sample has only three-fourths the value of the latter. For some years this subject of the valuation of milks engaged the attention of the author, who suggested the appended scheme in a lecture delivered before the Society of Arts in 1901. He had then for some considerable time employed a standard of valuation worked out on the following lines:—From an examination of a large number of commercial milks an average conventional standard of quality was first determined, the aim being not to go so low as the legal limit for adulteration, but to take figures which a buyer might reasonably demand to be reached in milks supplied to him. These were ultimately taken as being for

	New Milk.	Separated Milk.
Total solids, ...	12·5	9·3
Fat, ...	3·5	0·3
Non-fatty solids, ...	9·0*	9·0

At the time when these figures were adopted, the approximate wholesale prices of milk were, new, 10d. per gallon; separated, 2½ (2·5)d. per gallon. New milk differs essentially from separated in that it contains an excess of 3·2 per cent. of fat. According to the wholesale prices this excess of fat has a market value of 7·5d., and in the same proportion 3·5 per cent. of fat is worth 8·2d. From this the value of conventional standard samples can be expressed in terms of their constituents:—

	New Milk.	Separated Milk.
Fat, ...	3·5 = 8·2d.	0·3 = 0·7d.
Non-fats, ...	9·0 = 1·8d.	9·0 = 1·8d.
Per Gallon,	10·0d.	2·5d.

If the value of standard new milk be called 100, then the value of any other sample can from the analysis be expressed in terms of percentages of the standard from the following table:—

* This figure is in reality too high for the non-fatty solids in an average milk, but as it was desired to make the comparison between new and separated milk as simple as possible to those not familiar with analytic calculations, the same figure was adopted for each. The difference between 9.0 and 8·8 (the more correct figure) does not practically affect the valuations.

VALUATION OF MILKS.

Fat in Terms of Standard.

Fat per cent.		Percentage of Standard.		Fat per cent.		Percentage of Standard.
0·1	=	2·34	...	2·5	=	58·57
0·2	„	4·69	...	2·6	„	60·92
0·3	„	7·03	...	2·7	„	63·26
0·4	„	9·37	...	2·8	„	65·62
0·5	„	11·71	...	2·9	„	67·95
0·6	„	14·06	...	3·0	„	70·29
0·7	„	16·40	...	3·1	„	72·63
0·8	„	18·74	...	3·2	„	74·98
0·9	„	21·09	...	3·3	„	77·32
1·0	„	23·43	...	3·4	„	79·66
1·1	„	25.77	...	3·5	„	82·00
1·2	„	28·12	...	3·6	„	84·34
1·3	„	30·46	...	3·7	„	86·68
1·4	„	32·80	...	3·8	„	89·02
1·5	„	35·14	...	3·9	„	91·36
1·6	„	37·49	...	4·0	„	93·70
1·7	„	39·83	...	4·1	„	96·04
1·8	„	42·17	...	4·2	„	98·38
1·9	„	44·52	...	4·3	„	100·72
2·0	„	46·86	...	4·4	„	103·06
2·1	„	49·20	...	4·5	„	105·40
2·2	,	51·55	...	4·6	„	107·74
2·3	„	53·89	...	4·7	„	110·08
2·4	„	56.23	...	4·8	„	112·42

Non-Fatty Solids in Terms of Standard.

Non-Fatty Solids per cent.		Percentage of Standard.		Non-Fatty Solids per cent.		Percentage of Standard.
4·8	=	9·6	...	7·2	=	14·4
4·9	„	9·8	...	7·3	„	14·6
5·0	„	10·0	...	7·4	„	14·8
5·1	„	10·2	...	7·5	„	15·0
5·2	„	10·4	...	7·6	„	15·2
5·3	„	10·6	...	7·7	„	15·4
5·4	„	10·8	...	7·8	„	15·6
5·5	„	11·0	...	7·9	„	15·8
5·6	„	11·2	...	8·0	„	16·0
5·7	„	11·4	...	8·1	„	16·2
5·8	„	11·6	...	8·2	„	16·4
5·9	„	11·8	...	8·3	„	16·6
6·0	„	12·0	...	8·4	„	16·8
6·1	„	12·2	...	8·5	„	17·0
6·2	„	12·4	...	8·6	„	17·2
6·3	„	12·6	...	8·7	„	17·4
6·4	„	12·8	...	8·8	„	17·6
6·5	„	13·0	...	8·9	„	17·8
6·6	„	13·2	...	9·0	„	18·0
6·7	„	13·4	...	9·1	„	18·2
6·8	„	13·6	...	9·2	„	18·4
6·9	„	13·8	...	9·3	„	18·6
7·0	„	14·0	...	9·4	„	18·8
7·1	„	14·2	...	9·5	„	19·0

In the following table are given the results of analysis of some typical examples of milk, their value

in terms of standard and per gallon, assuming standard milk to be worth 10d. per gallon:—

Description of Milk.		Com-position.	Value in terms of standard.	Value per gallon.
1. Milk with 26 per cent. of added water	Fat............	3·2	74·98	
	Solids not fat	6·6	13·20	
		9·8	88·18	8·8d.
2. Milk deprived of 40 per cent. of its cream ...	Fat............	1·8	42·17	
	Solids not fat	9·1	18·20	
		10·9	60·37	6·0d.
3. Old Somerset House limit, below which milks were considered adulterated	Fat............	2·5	58·57	
	Solids not fat	8·5	17·00	
		11·0	75·57	7·5d.
4. Present legal limit ...	Fat............	3·0	70·29	
	Solids not fat	8·5	17·00	
		11·5	87·29	8·7d.
5. Author's conventional standard	Fat............	3·5	82·00	
	Solids not fat	9·0	18·00	
		12·5	100·00	10·0d.
6. Average composition of pure new milk ...	Fat............	4·0	93·70	
	Solids not fat	8·8	17·60	
		12·8	111·30	11·1d.
7. Very rich milk slightly watered	Fat............	4·3	100·72	
	Solids not fat	8·1	16·20	
		12·4	116·92	11·7d.
8. High quality sample of separated milk... ...	Fat............	0·4	9·37	
	Solids not fat	9·1	18·20	
		9·5	27·57	2·76d.

Attention is drawn to the fact that milk No. 7, although of highest value in terms of standard, shows, nevertheless, evidence of having been watered, and might possibly be made the subject of a prosecution if analysed for the purposes of the Food and Drugs Act. The public analyst is concerned simply with adulteration, while the commercial user is more vitally interested in the question of intrinsic value. The fact of such a milk as this being exceptionally rich in fat is not necessarily a defence to a prosecution for adulteration by the addition of water. The actually high value is nevertheless a fact which the defendant will do well to bring before the Court in view of a case, the report of which follows:—

Milk exceptionally good though water had been added.—In *Banks v. Wooler,* (1900, 64 J.P. 245), it was stated in the certificate of the public analyst that the "sample of milk . . . contained the parts as under:—Fat, 3·55 parts; non-fatty solids, 7·46 parts; water, 88·99 parts; total, 100. I am therefore of opinion that this milk contains 10 per cent. of added water. This opinion is based upon the above analytic result in conjunction with the fact that natural milk contains not less than 8·5 of non-fatty solids." It appeared to the justices that the milk was exceptionally good, the butter fat being above normal; and, having regard to all the circumstances, they thought that, though the charge was proved, the offence was of so trifling a nature that it was

inexpedient to inflict any punishment, and they therefore dismissed the information. It was *Held* by CHANNELL and BUCKNILL, J.J., that "This case must be remitted to the justices with the intimation that, if the milk had been exceptionally good after adulteration, they might have considered the offence too trifling to convict; but if the milk was only exceptionally good before adulteration the offence was not trifling, and they should convict."

On setting out the value of this sample from the analysis, according to the table previously given, the following figures are obtained:—

Fat, 3·55	82·17
Non-fatty solids, 7·46 ...	14·90
Value in terms of standard ...	97·07
" per gallon	9·7d.

This milk is therefore intrinsically worth 9·7d., as against 8·7d. as the value of milk of the lowest legal limit. The fact of milk being exceptionally good, even after being watered, entitles the justices to consider the case on its merits and dismiss it if they think the offence too trifling for which to convict. Exceptionally good quality, even in event of conviction, would almost certainly be regarded as a palliation of the offence, and its proof result in a mitigation of the penalty.

Board of Agriculture Regulations.—Certain powers have been conferred on the Board of Agri-

culture by the Sale of Food and Drugs Act, 1899, these being embodied in :—

"Section 4.—(1.) The Board of Agriculture may, after such inquiry as they deem necessary, make regulations for determining what deficiency in any of the normal constituents of genuine milk, cream, butter, or cheese, or what addition of extraneous matter or proportion of water, in any sample of milk (including condensed milk), cream, butter, or cheese, shall for the purposes of the Sale of Food and Drugs Acts raise a presumption, until the contrary is proved, that the milk, cream, butter, or cheese is not genuine or is injurious to health, and an analyst shall have regard to such regulations in certifying the result of an analysis under those Acts."

In pursuance of these powers the Board has adopted the before-mentioned limits for milk of the Society of Public Analysts. The Board does not, of course, say that the milk shall not be regarded as genuine when it contains less than the limit quantities, but requires the defendant to prove that any deficiency is compatible with its purity and genuineness.

Milk may be adulterated in many ways, among which occur the following :—

(1) Addition of water; this is probably the simplest. The result is a diminution of all the constituents in the same ratio.

(2) Abstraction of cream, which is skimmed off on rising to the surface; a variant of this is the addition of separated milk to new milk. By this the fat is diminished, while the other constituents remain comparatively unaltered.

(3) Carelessness in selling, whereby the cream is allowed to separate, and the resultant poor milk sold. In *Dyke v. Gover*, L.R., 1892, 1 Q.B., 220, it was *Held* by Coleridge, L.C.J., and Wright, J., that the onus of preventing the separation of cream from milk in the course of delivery lay on the vendor.

(4) Selling milk which is abnormal either through disease of the cow or unusual manner of milking. This was decided in *Smithies v. Bridge*, L.R., 1902, 2 K.B., 13, in which it was *Held* by Alverstone, L. C. J., that "If, however, the article produced, although it is produced by the cow, is the result of an abnormal condition of things arising either from disease or, as here, from unsound treatment of the cow, I think that that does amount to evidence on which the magistrates can find the article is not of the nature, substance and quality of the article demanded."

Analysis of Altered Milk.—In view of the fact that milk is peculiarly liable to alteration, and that appeals are frequently made to the Government analytic authorities, whereby there is much delay between the taking of a sample and its analysis, the problem of the analysis of an altered milk becomes

one of serious importance. In earlier days a system of time allowances was adopted. This was based on the assumption that the loss of non-fatty solids of a milk proceeds in all cases at about the same rate, and that after the first week it is fairly uniform. This position was laid down by Dr. Bell, the then Principal of Somerset House, in his *Analysis and Adulteration of Foods,* who there expresses the opinion that "With a carefully conducted analysis, . . . the error, if any, in making the allowance should not exceed 0·10 per cent. of the non-fatty solids, and in the case of watered milk the result should come within 1 per cent. of the quantity of water added, as previously estimated from the analysis of the fresh milk." Allen showed in a table published in the *Analyst,* XII. p. 231, the difference between the actual loss of solids which had taken place in samples of milk referred to Somerset House, and the loss calculated according to Bell's rule. The figures showed errors in the total solids ranging from +0·79 to −4·07 per cent. The time allowance system was long a bone of contention between Somerset House and Public Analysts, and in 1894 (*Analyst,* p. 248) was forcibly described by Hehner as having "been nothing short of scandalous."

More recently, under the direction of Thorpe, the present Principal of the Government Laboratories, a new system of examination of altered milks has been introduced. The fat and non-fatty solids are estimated by recognised methods. Then determinations are made

of the more important volatile bodies into which the non-fatty solids have been decomposed. These consist of alcohol, acetic acid, and ammonia. From the amount of these bodies, that of original milk solids, which must have been destroyed for their production, is calculated, and is added on to that found on the determination of such solids. A communication on the subject of this new method was made to the Society of Public Analysts by Droop Richmond and Miller, and reported in the *Analyst*, XXXI. 317. Their general conclusions are :—"By the method used in the Government Laboratories a satisfactory determination of the composition of the original milk can be made, the results, except in cases of high butyric fermentation and other abnormal decompositions, not being more than 0.2 per cent. from the truth." Thorpe, Principal of the Government Laboratories, who was present, rejoined :—"In actual practice, however, we find the cases extremely rare in which the volatile acids exceed 0·27. . . . The conclusion of Messrs. Richmond and Miller is that in general a substantially accurate determination of the original solids of the milk can be made by the method in use at the Government Laboratories."

Milk Calculations.—Although very simple, the calculation of "added water" appears frequently to present considerable difficulties even to advocates and the Court when adjudicating on milk cases. The first point to recollect is that all such calculations are based

on the adoption of some minimum standard such as the 8·5 and 3·0 per cent. limit. If for any reason the Court refuses to apply the standard to a particular milk, all calculations based thereon must of necessity fall to the ground. But if the standard be accepted and applied, then suppose a milk contains only 8·0 per cent. of solids not fat,—as 8·5 parts are contained in 100 parts of the poorest pure milk, then 8·0 will be contained in 94·1 parts according to the following calculations:—

$$\text{As } 8{\cdot}5 : 8{\cdot}0 :: 100 : 94{\cdot}1$$

$$\frac{8{\cdot}0 \times 100}{8{\cdot}5} = 94{\cdot}1$$

In 100 parts of such milk, 94·1 may be regarded as consisting of milk of the lowest limit, and evidently

$$100 - 94{\cdot}1 = 5.9 \text{ parts}$$

must be regarded as consisting of added water.

Another point of difficulty is in the return of the amount of fat in the milk. If an analyst finds only 2.95 per cent. of fat in a milk, when there ought to be at least 3·00 per cent., there is evidently a deficiency of 0·05 per cent. That is to say, 100 lbs. of the milk contain only 2.95 lbs. of fat, whereas such quantity ought to contain 3·00 lbs.; and the fat is deficient in the milk to the extent of 0·05 lbs. in the 100 lbs. Many analysts, however, elect to also express their results in terms of percentage of the minimum amount

of fat that ought to be present. Thus, in the case being considered, the following calculation is made:—

$$\text{As } 3{\cdot}00 : 2{\cdot}95 :: 100 : 98{\cdot}33$$

$$\frac{2{\cdot}95 \times 100}{3{\cdot}00} = 98{\cdot}33$$

That is to say only 98·33 per cent. of the least amount of fat that ought to be in the milk, 3·00, is found, and therefore there is a deficiency of 100 - 98·33 = 1·67 per cent. of the total fat that ought to be present. If it be remembered that this figure is only a percentage of a percentage, no harm is done; but this is not quite realised by many chemical laymen (among whom magistrates are included). They are consequently apt, when told there is a deficiency of 1·67 per cent. of the fat, to assume that, as the minimum fat should be 3·00 per cent., the milk contains only 3·00 - 1·67 = 1·33 per cent. of actual fat, whereas, of course, the correct figure is 2·95 against 3·00 per cent. Care should be taken by both the prosecution and defence (and especially the latter) to ensure that the justices quite understand the meaning of this mode of expressing the results of an analysis.

Butter.—The most important adulterations of butter are those of the addition of excess of water, and of fats other than that derived from the milk of the cow.

One of the most interesting and instructive tests applied to butter is that of determining the amount of

volatile fatty acids yielded by the fat of the sample under exact conditions. There is a considerable amount of such volatile acids in butter, while they are practically absent in beef fat and cottonseed oil, two frequent adulterants. To separate and exactly determine the whole of these volatile acids is a somewhat difficult and tedious operation. But when the fat is treated in a specified way, and distilled in an apparatus of a specified kind, a fraction of the volatile fatty acids distils over, which is constant for the same fat. This distilled fraction is estimated by noting how many volumes of an alkali of known strength (decinormal) are required to neutralise it. Without any other calculation such number of volumes is termed after the inventors of the process, the "Reichert Meissl (R.M.) value." Butter has an R.M. value of about 28·0, while nearly all other oils and fats have less than 1·0. The principal exceptions are fish oils, the R.M. value of which ranges from 45·0 to 65·0. From their odour and taste, these however cannot be used as adulterants of butter. Cocoanut fat has an R.M. value of about 7·0, and that of palm nuts of about 5·0. Both of these latter may be used in butter substitutes.

If this mean R.M. value of butter fat at 28·0 were absolute, then in the case of an unknown sample giving 28, the butter fat would be regarded as free from all foreign fats (except the impossible fish oils). If the sample gave 14·0, this might possibly indicate 50 per cent. of pure butter ~~and 50 per cent.~~ of fat

with no R.M. value. In the same way R.M. values, 0 to 28 would correspond with 0 to 100 per cent. of butter fat. This is the principle of all such methods of analysis. There may, however, be complications, such, for example, as the presence of cocoanut fat. Thus, suppose a mixture to consist of—

Butter fat - - -	40 parts.
Cocoanut fat - - -	40 „
Beef fat - - -	20 „
	100

Such a mixture would also have an R.M. value of 14·0. There is, therefore, this element of uncertainty, and further tests would be required to prove the presence or absence of cocoanut fat. This uncertainty is of no help to the defence, for with an R.M. value of 14 the adulteration must be at least 50 per cent., and if cocoanut fat were used the amount would, of necessity, be larger, as is the case in the mixture suggested.

Variations in R.M. value.—But *the R.M. value of butter fat is not constant.* The values on record range from as low as 19·8 for an Italian butter to so high as 33·1 for an Austrian butter. The extreme figures, in most cases, are due to exceptional circumstances which do not usually occur. These variations may be caused by alteration in the mode of feeding the cows, by the period of lactation, and other circumstances. This leads to the consideration of *fluctuations*

in such standard values. Taking 28 as a mean for R.M. value, the fluctuations in the case of butter fat, may easily range anywhere between 26 and 30 without being in any way abnormal. Reading analytic results in the light of this fact, any butter coming within these extremes must be regarded as pure. It becomes necessary, then, to fix a *minimum standard.* As a matter of fact, anything below 26 is suspicious, but obviously some margin must be allowed. As an *official minimum R.M. value for butter fat* the figure 24 is adopted in England, France, and Germany. This operates considerably in favour of the vendor; for butter with a very high R.M. value will bear 20 per cent. adulteration with foreign fat, while an ordinary butter will take 10 per cent. without falling below the minimum. (It must not be understood to follow that such adulteration may not be detected by other tests).

Of necessity any minimum, such as is here adopted, must be of a somewhat arbitrary nature. In this there is a loophole for defence. It may be argued that if a butter with R.M. value as low as 24·0 is to be regarded as pure, then a butter at 23·9 is not necessarily impure. It must, of course, be admitted that the 23·9 butter *may be* pure. But the chemist's position is based on the fact that a very generous margin has already been allowed, hence it is a practical certainty that the 23·9, or even 24·0, sample is not pure. This minimum falls well below all normally pure samples of ordinary origin, and all excluded

butters should be regarded as impure, unless some good cause for such irregularity is shown by the defence. Voelcker, referring to Siberian butters, says they "are made under certain conditions of climatic temperature, &c., vastly different from those of our own country . . . this butter has been found to give results as regards the volatile and non-volatile fatty acids, of quite abnormal nature." *Analyst*, XXVII., 85. Where facts of this kind are clearly proved the defence should succeed; and in fact, analysts themselves take carefully into consideration the country of origin of the butter before deciding as to its adulteration. It follows that this should be ascertained and stated when possible. When a purchase of butter is made, the source of origin of which is unknown, the difficulty of rightly interpreting the results of analysis is undoubtedly increased by the abnormally low R.M. value of Siberian butters. Probably the best course is to apply certain other well-known tests, and if these confirm the deductions drawn from the low R.M. value, to regard such butter as adulterated, allowing the defence to raise and *prove* the country of origin and consequent purity of the butter. As a measure of precaution, the retailers of such butters will be wise to obtain from the wholesale vendors a warranty of the country of origin.

Right of Purchaser to Normal Article.—In such cases the prosecution is usually strengthened by the right of the purchaser to have a *normal article*. The

article sold must be "of the nature, substance and quality of the article demanded." The presumption is that the purchaser requires an article of fair normal quality. When that sold falls below a minimum standard, is the purchaser prejudiced? The deficiency may be due to the addition of an adulterant, or to abnormal modes of production, such as making butter from the milk of improperly or carelessly managed cows. Now deficiency of fat in milk is clearly of prejudice to the purchaser, but is it so with deficiency of volatile fatty acids in butter? The following is an important expression of opinion. He, Hehner, "could not see with his present knowledge of the subject how anyone who obtained a smaller proportion of soluble or volatile fatty acid in his butter was prejudiced, as the quality of the butter appeared to be independent of the composition as regards soluble and insoluble fatty acids," *Analyst*, XVIII. 12.

In passing, it may be mentioned that margarine manufacturers have informed the author that they prefer, for mixing purposes butters having a high R.M. value, as they regard such butters as possessing stronger flavouring properties.

Errors of Experiment on Border Line.—Still taking the butter case of 23·9 as against 24·0 R.M. value, the defence may allege that the errors of experiment may be as great as the stated deficiency. In such near cases the analyst should be prepared with duplicate analyses showing agreement. If possible, it

is well to show that the error of experiment must be in favour of the vendor. The analyst ought to be able to say "I have taken such precautions as will prevent any sensible error of experiment, and even if there were any minute error, it is in the direction of over-estimating the essential constituent." The defence may insist strongly on liability to error. Thus, in a milk prosecution, it may be said the milk contains only 2·5 per cent. of fat. A chemist for the defence may reply, no, it contains 3·1 per cent. of fat, which I have extracted and can produce. Obviously one cannot obtain more than is there, but it is possible to use a process which fails to extract all there is present. Within the author's personal knowledge, duplicate samples of the same substance have been sent to an analyst under different marks; the returned results have differed from each other by a greater amount than the deficiency on which he, the analyst, had advised a prosecution.

Spent Ginger.—This despicable form of fraud is perpetrated by taking ginger from which the essential flavouring constituents have been extracted, mixing it in with more or less fresh ginger and selling the whole as pure ginger.

An interesting case was tried at Newport, Salop, in September, 1896. Blunt, public analyst, for the prosecution, reported a sample of powdered ginger as adulterated with spent ginger to the extent of 25 per cent., on the following data:—

Total ash	2·74	per cent.
Soluble ash	1·24	„
Cold water extract ..	6·20	„

He based his view that the sample was adulterated on the fact that it contained too little of the above, which are the characteristic constituents of ginger.

For the defence, Collingwood Williams, analyst, was called. He deposed that he "found it to be genuine ginger of high quality, and absolutely free from spent ginger. . . . Would have detected spent ginger by changed shape of starch granules." (This is dependence on an alleged difference in microscopic appearance caused by the act of extraction). . . . "Further chemical tests showed presence of 6 per cent. resin and 1·25 per cent. of essential oil, being perfectly normal quantities." (These were estimations of essential constituents brought forward to traverse the low figures advanced by the prosecution). This case was dismissed by the Court of summary jurisdiction.

Blunt reported the result of the trial to a meeting of the Society of Public Analysts, and denied the possibility of deciding whether or not spent ginger was present by means of the microscope.

C. Williams was written to asking him to communicate his views on the case to the Society. This he declined to do on the principle that it was not right to re-try a decided case in that way in the absence of the accused. But writing generally on the analysis of ginger, he re-affirmed that microscopic examination

often has the advantage of affording direct evidence [of extraction] as distinguished from the circumstantial evidence of chemical analysis. He admitted, however, that ginger could be exhausted by alcohol without affecting the microscopic appearance. When exhausted by rectified spirit the extraction is not detectable by estimations of total ash, soluble ash, and cold water extract, but when extracted by water or very dilute spirit, soluble ash, alcoholic extract, and essential oil will be reduced; and invariably a greater or less change in microscopic appearance will have been produced. Cold water extract is of little value as evidence, but analysts should be careful to avoid being misled by same, as the amounts vary very much in different kinds of genuine ginger. Low soluble ash and total ash, when nothing else is low, may indicate a high class of ginger and not a fraudulent sample. Chemical evidence is the most important and truest, but only when the analyst's mind is impressed by the important ingredients rather than by the unimportant ingredients.

Allen had analysed the same sample as Blunt, and also genuine Cochin ginger, said to be the same as the Newport sample [*i.e.* before exhaustion]. He obtained the following results:—

	Total Ash.	Sol. Ash.	Cold Water Extract.
Newport sample—			
Allen, ...	2·65	1·30	6·20
Blunt, ...	2·74	1·24	6·20
Cochin ginger, ...	4·62	2·64	10·20

He regards soluble ash and cold water extract as among the most useful data in examining gingers, as it was evident that they would be materially diminished by any process of maceration, whereas such treatment would not necessarily affect the essential oil and resin. He regards these latter figures as having no practical value, and was satisfied that the Newport sample contained a notable proportion of exhausted ginger. (*Analyst*, XXI., 309).

On the analytic data, the general consensus of opinion of the Society was that the sample in question had been adulterated.

Lard Analysis.—Lard is the rendered (melted down) and clarified fat of the pig. The fat surrounding the kidneys is much harder than that of the whole carcase, and makes a firmer and better quality lard. To the soft or whole hog lard, beef stearin, the harder part of beef fat, is sometimes added as an adulterant. There can be little doubt that the lard for many purposes is improved thereby. If sold as mixed or hardened lard, there could be no objection to this treatment; but when sold as best or hog kidney lard, an offence is committed, as such mixed lard cannot be regarded as of the substance of the article demanded. An interesting query may here arise. The principal difference between the kidney fat lard and that of the whole animal is that the former contains a higher proportion of lard stearin (the harder part of lard), while the latter contains an excess of the oily constituent of lard. It is possible to

harden whole hog lard by expressing some of the lard oil therefrom, and thus making it closely resemble, if not identical in composition with, the kidney lard. The lard would be thus improved, but would such treatment be adulteration? If sold as kidney lard, the answer must be in the affirmative. But if sold as "lard," it is not easy to give a definite answer. Where there is nothing present but hog fat, the removal of a portion which deteriorated the quality, and thus improved the remainder, would not be likely to be regarded as an act of adulteration.

In the analysis of lard, crystals of the stearin or harder fat are separated out and examined microscopically. Those of lard, as commonly obtained, have characteristic chisel shaped ends, while beef stearin crystals are needle shaped. Hehner and Mitchell have investigated the shape of these crystals by several times re-dissolving and re-crystallising the stearin. They found the first crystals had characteristic chisel shaped ends. On re-crystallisation they were more needle shaped, but still had distinct chisel shaped ends. On being again re-crystallised they were hardly distinguishable in form from beef stearin crystals. The difference in "form of the beef crystals is solely due to a larger proportion of stearic acid than can be obtained from a pure lard by a single crystallisation." (*Analyst*, XXI., 328).

Hehner reports a further experiment in which he melted out in his laboratory from pig's flare some lard with iodine absorption of only 45·6—"Crystals from this sample are indistinguishable from those of lard

largely admixed with beef fat." (*Analyst*, XXVII., 165). It would seem therefore that the different microscopic appearance of lard and beef stearin crystals is not due to any inherent difference between the two stearins. but only to the fact that beef stearin contains a larger proportion of stearic acid than can readily be obtained from lard stearin.

Dyed Sugar.—Sugar as refined in this country consists usually of colourless crystals, and is largely prepared from beet roots. Sugar in the West Indies is obtained from the juice of the sugar cane. Although this sugar may also be refined until white or colourless, considerable quantities are or have been imported in the form of large yellow crystals and sold under the name of "Demerara sugar." Chemically speaking, both beet and cane sugar are identical in character and composition. Using the word cane as an adjective to indicate a particular chemical variety of sugar, both sugar-cane and beet-root sugars are equally cane sugar, or "sucrose" in more strictly chemical nomenclature. From whichever source, when pure, it is doubtful if they can be distinguished by any ordinary means. There is, however, one great difference between them: the whole juice of the sugar-cane consists of pleasant smelling and tasting substances. In consequence, when the sugar has been crystallised out from the juice during evaporation and concentration, the residual liquid has a sufficiently pleasant flavour to find a ready sale under the name of treacle or molasses. With beet-root juice,

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on the other hand, the associated substances in the juice are unpleasant in flavour and smell. On the removal of the sugar, therefore, the remaining body is devoid of the pleasant character of cane-sugar molasses. As a result it is desirable to separate beet root sugar as thoroughly as possible from the other substances in the juice, while in the case of cane sugar these bodies are not only unobjectionable, but may add a character to the sugar which some purchasers actually prefer. The public appreciation of sugar of the "Demerara crystals" type is largely based on the view that it is genuine sugar-cane, and not beet-root, sugar, and that it is coloured by the natural colouring matter of the sugar-cane juice.

Cassal communicated a paper to the Society of Public Analysts on the subject of "Dyed Sugar." In this paper he states that "large quantities of dyed sugar are sold in London and elsewhere — generally as Demerara sugar." The crystals are dyed on the surfaces. The purchasers' impression is that they are having genuine cane sugar, whereas they are thus getting beet sugar externally dyed. It is generally admitted that weight for weight under ordinary conditions of use, beet sugar does not give the same sweetening as cane sugar.

On the other hand Demerara sugar itself, in the course of manufacture, is dyed before crystallisation. Cassal, nevertheless, contends that the dyed crystals are adulterated. A warning is given not to state too specifically the nature of the dye used, as the defence

might be able to state that the particular dye was not present.

Stokes, in discussion, stated that almost all Demerara sugars contain about a third of a grain of stannous chloride per lb. Most other sugars are artificially coloured with aniline colours. [White sugars are invariably "blued."] He suggested that fictitious Demerara sugar should be stopped by the "Merchandise Marks Act." Demerara retains the natural aroma, tint and flavour of the sugar cane; stannous chloride is used as a *mordant* for the purpose of fixing these.

Heron. Demerara manufacturers used stannous chloride to improve inferior sugars, so as to make them look of better quality than they really were, and cause them to simulate the higher qualities. The home-dyeing of crystals was not done to give a fictitious value, but to meet the public taste.

Hehner considered that the public analyst has to disregard popular wishes and raise the standard of purity of food, if necessary, *against* the popular wish.

Cassal in reply insisted that Demerara was cane sugar, and dyed crystals beet sugar, *Analyst*, XV., 141.

There were here some interesting differentiations of sophisticated articles. No one urged that dyed Demerara should be prosecuted. In the *Analyst*, XV., 199, there is a letter on the subject by Scand, chemist to the Colonial Sugar Company. He states that stannous chloride is added to the magma of crystals and mother liquor, for the purpose of fixing the natural colour of the cane juice on the sugar. Beet sugars are

changed here into "refiner's yellow crystals" as imitations, and it is a fraudulent substitution.

The *crux* of the whole matter seems to be contained in Cassal's reply, namely, that Demerara sugar is sugar-cane sugar, and that the dyed crystals are beet-root sugar, whereas when the public ask for Demerara it is really sugar-cane sugar they demand and think they are getting. Hehner's conception of the duty of the public analyst to raise, if necessary, the standard of purity of food *against* the popular wish suggests the interesting question of whether you can be acting to the prejudice of the purchaser when you give him exactly what he demands. *Per contra* if the purchaser prefers "dyed sugar," and asks for dyed sugar, would not the sale of natural sugar, however much better it would be for him, be a sale to the prejudice of the purchaser?

One curious result of the campaign against dyed sugar is that the name "Demerara" as applied to sugar has for retail purposes gone almost entirely out of use. The sale of Demerara crystals involved grocers in such risk of prosecution for adulteration, of which they were often unaware, that they have largely decided to run no risks and to discontinue stocking the article.

No legal Standard of Manufacture.—This point arose in the case of *Smith v. Wisden*, 1902, 66 J.P., 150. The appellant, a grocer, sold a pot of marmalade, which was certified by the public analyst to contain

"the parts as under or the percentage of foreign ingredients as under,

Starch glucose ... 13 per cent."

It was proved before the Court of Quarter Sessions that starch glucose is composed of 40 per cent. of dextrose, 40 per cent. of dextrin, and 20 per cent. of water. That dextrose is sugar to all intents and purposes, but that dextrin is a gummy substance and has not any sweetening property whatever. The Court of Quarter Sessions found, *inter alia*, that in asking for orange marmalade the purchaser desired to buy a substance composed of oranges cooked or preserved with cane or beet sugar, and had not consented to be served with a preserve to which starch glucose was added. They, therefore, affirmed the conviction by the magistrates. A case was stated and heard before ALVERSTONE, L.C.J., DARLING and CHANNELL, J.J. In course of judgment ALVERSTONE, L.C.J., said—"I should not have come to the same conclusion, that a man, when he asked for "marmalade," thought he was going to get fruit and beet or cane sugar. I think there are many other things that might properly be put in good marmalade that a man asking for it would not know of, or would not form any opinion about . . . What have the magistrates found? It was proved that glucose had been used in the manufacture of marmalade for a period of fifteen years by a large number of manufacturers, but not by all. Therefore it is plain that they found as a fact that it was

an alternative ingredient in marmalade. They say there was a general and common understanding that marmalade was composed of fruit boiled with cane or beet sugar, but that there was no legal standard for the making of marmalade, and that manufacturers varied in the recipes they used. Now, so far, we get a certain thing found, viz., that there is no standard, but a frequent but not uncommon use of glucose varying the recipe. Then they find this, that the use of glucose to the extent contained in the analysed articles was not injurious to health, that it prevented the marmalade from crystallising, and had a tendency to prevent mildewing and fermenting. Now, looking at the thing fairly, and not endeavouring to construe this Act, so that it be a weapon of oppression or otherwise than a proper protection of the public, what does that amount to? . . . The purchaser . . . got an article given to him which, if it was different at all, was different in the sense that it was rather better. . . . There was no evidence of any inferior quality or of any adulteration in the ordinary sense of the word. The appeal must be allowed and the conviction quashed." DARLING and CHANNELL, J.J., agreed.

Where there is no legal standard for a manufactured article, it may be taken that the addition of an ingredient which does not lower the quality, and does not constitute adulteration in the ordinary sense of the word, is not in itself an offence.

CHAPTER III.

ADULTERATION OF DRUGS.

Drug Adulteration Cases.—The author is indebted to the *Chemist and Druggist* for the majority of the following cases in illustration of the application of the Food and Drugs Acts to the adulteration of drugs. Many of the cases are only decisions of Courts of Summary Jurisdiction, and therefore cannot be quoted as authority. They serve, however, to indicate what is the general trend of magisterial opinion in the matters referred to.

Acetic Acid.—In April, 1895, an Islington chemist is reported to have been summoned for selling 11·7 per cent. acetic acid as "diluted acetic acid." This acid was of higher strength than standard "diluted acetic acid," and the question arose whether or not such sale was "to the prejudice of the purchaser," since that supplied was in one sense of better quality than that demanded. The magistrate held himself bound by *Knight v. Bowers*, 1885, 14, Q.B.D., 845, in which it was decided that if the article supplied, even

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though unadulterated, was wholly different from that demanded by the purchaser, an offence had been committed. (*C. and D., 16th. April, 1895.*)

It cannot be said that a somewhat stronger acetic acid is a wholly different article, but it must be remembered that the standard to be applied to drugs is a different one from that applied in the case of food. It can scarcely be imagined that any purchaser would feel himself prejudiced by the sale of milk containing twice the usual quantity of cream; but if a drug be supplied of twice its proper strength, its administration may be most harmful instead of beneficial to the patient.

Arsenical Soap.—There have been several prosecutions for the sale of soap as "arsenical soap," which contained little or no arsenic. At Brentford convictions were obtained on the ground that the soap was a drug, and did not contain an essential quantity of that which was represented as the actual constituent. In the case of *Houghton v. Taplin*, 1897, 13, Times L.R., 386, there was an appeal to the Court of Queen's Bench. WRIGHT, J., held that the soap was a compounded drug within the meaning of S. 6, s.s. 3 of the Act, and therefore was within the proviso. HAWKINS, J., held that the soap was not a drug *per se*. The magistrates had refused to convict, and their decision was therefore upheld on appeal.

British Pharmacopœia as a Standard.—Drugs

asked for by popular names do not necessarily mean the articles so designated in the British Pharmacopœia, but *prima facie* it is assumed by judges that they do until the contrary is proved. The Acts lay down no standards for drugs, but the majority of decided cases favour application of British Pharmacopœia standards to articles sold under British Pharmacopœia names. The following are the more important High Court (English) decisions:—

White v. Bywater.—The Sheffield Medical Officer of Health bought 3 oz. of tincture of opium, which on analysis was found to be deficient both in opium and spirit when compared with that specified in the British Pharmacopœia. On appeal to the Queen's Bench Division (Q.B.D.), it was *Held* that the respondent ought to have been convicted although the purchaser had not specifically asked for tincture of opium prepared according to the British Pharmacopœia —(1887), 19, Q.B.D., 582.

Beardsley v. Walton & Co., Ltd.—Camphorated oil containing 8 per cent. of camphor was sold, and W. & Co. were summoned under Section 6 of the 1875 Act. The justices found that the oil is a "compounded drug" (Section 6, Sub-section 3), and therefore that proceedings should have been taken under Section 7. *Held* in the Q.B.D. that there is no definition in the Act of what is a drug "compounded as in this Act mentioned," so that no meaning can be given to the words in Sub-section 3. Camphorated oil is not a drug "compounded as in this Act

mentioned," and the prosecution was properly brought under Section 6.—(1900), 2, Q.B.D., 1.

Dickins v. Randerson.—A chemist managing a branch of Taylor's Drug Stores, Ltd., was asked for "mercury ointment," and supplied an ointment containing 12·5 per cent. of mercury instead of 48·5 per cent., as in the British Pharmacopoeia. He was convicted under Section 6. On appeal to the K.B.D. it was *Held* that the appellant was properly convicted under Section 6, as, in the absence of a prescription by a medical practitioner, he ought to have sold the article according to the standard in the Pharmacopoeia; and that he might probably have also been convicted under Section 7 of selling a "compounded drug which is not composed of ingredients in accordance with the demand of the purchaser." (Section 15 of the Pharmacy Act, 1868, as to compounding British Pharmacopoeia medicines according to the formularies thereof was held to be proof that there is no standard for mercury ointment different from the Pharmacopoeia).—(1901) 1, K.B.D., 437.

Hudson v. Bridge.—Vinegar of squills was sold. It contained less acetic acid than is prescribed in the British Pharmacopoeia formula, and the seller was convicted, although evidence proved that in the vinegar, even if properly kept, a change or decomposition takes place which reduces the quantity of acetic acid. On appeal it was *Held* that the justices were wrong, as there was no evidence that the purchaser in asking for vinegar of squills demanded the

proportion of acetic acid in new vinegar of squills, and that the hypothetical standard set up by them could not be supported. It was further held that as the vinegar is liable to decomposition the public analyst should have mentioned the fact in his certificate.—(1903), 19, Times L.R., 369.

Boots Cash Chemists (Southern), Ltd., v. Cowling.—The appellants sold methylated soap liniment, and were convicted under Section 6, the magistrate refusing to receive evidence that there is a commercial standard for liniment of soap different from that prescribed by the British Pharmacopoeia. The magistrate relied on *Dickins v. Randerson.* The K.B.D. (ALVERSTONE, L.C.J., and WILLS and CHANNELL, J.J.) *Held* that the evidence as to commercial standard is admissible, and that PHILLIMORE, J., "never meant to lay down in that case that nothing could be looked at except the British Pharmacopoeia. On the other hand, if it was the sale of some drug recognised by a special name in the British Pharmacopoeia, a very strong *prima facie* case would be made out as to what the drug ought to contain."—(1903), 19, Times L.R., 370.

Bundy v. Lewis.—An unqualified assistant of respondent was asked for 4 oz. of paregoric, and supplied a liquid free from opium, striking out the word "poison" on a paregoric label and replacing it with "substitute." The purchaser (Bundy) observed this when dividing the sample, but prosecuted under Section 6, 1875, and the justices dismissed the summons on the grounds (1) that the sale was not to the

prejudice of the purchaser, and (2) that the respondent was protected by Section 8, 1875, by the label disclosing the fact that the article was paregoric substitute and not paregoric. On appeal, *Held* by the K.B.D. that the sale was not to the prejudice of the purchaser.—(1908), 72, J.P., 489.

It is an interesting fact that when the Food and Drugs Act, 1875, was drafted as a bill, it contained a provision making the British Pharmacopœia the standard for the quality of drugs, but this provision was eliminated from the bill before it became law. Dr. J. Attfield, the editor of the British Pharmacopoeia, pointed out at the Pharmaceutical Conference, July, 1899, that that work is not specified in the Sale of Food and Drugs Acts as the standard for drugs.

Castor Oil Pills.—A chemist was summoned for selling as "castor oil pills," pills which were certified by the public analyst to contain rhubarb, aloes, ginger, &c., but no castor oil. In cross-examination the analyst admitted that there might be 1·5 or 1·75 per cent. of castor oil in the pills, but that he should call that amount equivalent to none. For the defence it was alleged that it was usual to name compound pills from one of the ingredients, and that the name here implied that the effects were similar to those of castor oil. There could be no idea of fraud, because the other ingredients were much the more expensive. The magistrates convicted. (*C. and D., 15th. April, 1879.*)

A shopkeeper was summoned under Section 6 for selling castor oil pills, certified by the analyst to be composed of ingredients other than castor oil. The pill boxes were wrapped in a handbill stating that they "contained the finest cold-drawn castor oil, together with the choicest Pharmacopoeia ingredients, compounded so as to produce the effect as nearly approaching that of castor oil itself as possible without any of its unpleasantness. We wish it to be understood that the purgative effects are not caused by castor oil alone, as that would be impossible, but by the choicest ingredients of the Pharmacopoeia." This label was held to be a sufficient disclosure of the composition of the pills to secure the dismissal of the summons. *(C. and D., 25th. May, 1895.)*

Chewing-gum.—This is a well-known American confection, and consists of paraffin or wax, compounded with sugar and various flavouring ingredients. The object of the preparation is to provide something that shall be chewed and not swallowed in the solid state, the residual wax being finally spat out. In *Shortt v. Smith,* the appellant purchased at the respondent's shop three sticks of chewing-gum. These were labelled—"For chewing only; not to be eaten." Upon analysis it was proved to contain 35 per cent. of paraffin wax. The public analyst gave evidence that he was of opinion that the use of such a mixture might prove injurious to the consumer. Gums equally as insoluble as paraffin wax could be used. The

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A shopkeeper was summoned under Section 6 for selling castor oil pills, certified by the analyst to be composed of ingredients other than castor oil. The pill boxes were wrapped in a handbill stating that they "contained the finest cold-drawn castor oil, together with the choicest Pharmacopoeia ingredients, compounded so as to produce the effect as nearly approaching that of castor oil itself as possible without any of its unpleasantness. We wish it to be understood that the purgative effects are not caused by castor oil alone, as that would be impossible, but by the choicest ingredients of the Pharmacopoeia." This label was held to be a sufficient disclosure of the composition of the pills to secure the dismissal of the summons. (*C. and D., 25th. May, 1895.*)

Chewing-gum.—This is a well-known American confection, and consists of paraffin or wax, compounded with sugar and various flavouring ingredients. The object of the preparation is to provide something that shall be chewed and not swallowed in the solid state, the residual wax being finally spat out. In *Shortt v. Smith*, the appellant purchased at the respondent's shop three sticks of chewing-gum. These were labelled—"For chewing only; not to be eaten." Upon analysis it was proved to contain 35 per cent. of paraffin wax. The public analyst gave evidence that he was of opinion that the use of such a mixture might prove injurious to the consumer. Gums equally as insoluble as paraffin wax could be used. The

paraffin wax would not dissolve in the mouth, but some portions might be swallowed, and, if so, it would be injurious to health. The appellant contended that during the chewing some portion would be swallowed and the article thereby rendered an article of food. The respondent argued that the article was regarded by the public as a chewing-gum or wax, and sold accordingly. Having regard to the label, and that the wax would not dissolve in the mouth, the justices decided that the article was neither a food nor a drug, and dismissed the case. An appeal, CAVE and WRIGHT, J.J., decided that the justices were right in finding that this was not an article of food, and dismissed the appeal. (1895) 2, Times L.R., 325.

The case is of some interest because of the quibbling around whether or not this was an article of food. If gums equally as insoluble as paraffin wax were used, they would equally be likely to cause injury to health if swallowed. No doubt the chewing-gum contained sugar in considerable quantity, and to that extent was really a food. But what was sold in this case was an article specially prepared to meet a particular requirement, that being a pleasant flavoured confection that shall be capable of being chewed and yet remain in the mouth. If, in response to a demand for chewing-gum, a substance of the type of a gelatin lozenge were sold, the sale would be in fact one to the prejudice of the purchaser, as the article would be unfit for the purpose for which required.

Citrate of Magnesia.—This is the popular name of a well-known granular effervescent preparation, in which little or no true magnesium citrate is present. A Greenock chemist was prosecuted for selling as citrate of magnesia an article alleged to be adulterated with carbonate of soda, tartaric acid, sugar, and sulphate of soda. The defence proved that the substance sold was what is known commercially as "citrate of magnesia," and medical evidence was also given that when the witnesses prescribed citrate of magnesia they meant the article as sold by the defendant. On this evidence the magistrate found the defendant not guilty. (*C. and D., 15th. November, 1875.*)

Dispensing.—The price charged for making up a prescription is usually governed by the skill requisite in dispensing, rather than the actual cost of the ingredients. Any gross inaccuracy in so dispensing is an offence against Section 7 of the Act, whether the ingredients be either in excess or in deficit of those demanded by the purchaser. Where, however, the drugs are expensive, occasions happen in which a deficiency in the actual drug may be a considerable source of extra profit to the vendor. The following are representative cases of prosecutions for incorrect dispensing.

A chemist was fined for dispensing a mixture found to contain 36 instead of 120 grains of iodide of potassium. The defendant submitted that the medi-

cine as ordered was too strong, and that he had reduced it in the exercise of his discretion. (*C. & D., 15th. June, 1885.*)

A Buxton chemist was summoned for selling a 10-oz. potassium iodide mixture, which contained 142½ instead of 160 grains of the iodide. The defence was that 160 grains had been put in and the bottle filled up, so that it was possible that the analyst, taking a small measured quantity, would find less in the portion, although the whole was right (owing to bottle inaccuracy). The medicine was to be given in parts. Evidence in proof of this, and the purity of the iodide was adduced. The magistrate dismissed the summons, remarking that "the custom of filling the bottles up from the tap is, to say the least of it, lax." (*C. and D., 12th. January, 1890.*)

It is a well known custom in the dispensing of medicines to direct that, say, "an eighth part is to be taken" for a dose. To meet this form of prescription, bottles are made in which one-eighth divisions are shown by lines across the side. If in the case in question the bottle taken had really held 11 instead of 10 oz., then assuming 160 grains to have been dispensed, each eighth part would still have contained 20 grains of the iodide, although each 1¼ oz. (the eighth part of 10 oz.) would only contain 18·2 grains. Eight times 18·2 is 147·6, so that if the error in the bottle had been as much as 1 oz., the deficiency would not thus be accounted for. It is exceedingly doubtful whether any ordinary medicine bottle would

have an error of anything like an ounce in ten of its nominal capacity. The analyst might have taken for his analysis the measured quantity shown by the divisions on the bottle, but it is extremely unlikely that an analyst would adopt such a rough and ready method of measurement. Where a medicine is directed to be taken in eighths or other number of parts, it is difficult to see what arrangements could conveniently be made for dispensing, other than putting all the ingredients in a bottle and then filling it with water.

A chemist, who had contracted to supply medicines to the local Union, was summoned and convicted for dispensing a mixture which should have contained 2 grains of sulphate of quinine per oz., and was found on analysis to contain only 0·64 grains per oz. (*C. and D., 15th. May, 1881.*)

A London chemist received a prescription for 66 grains of iodine and 99 grains of potassium iodide in 3 oz. of water. He dispensed it, and the analyst reported that the solution showed a deficiency of 14·5 per cent. of iodine and an excess of 9·3 per cent. of potassium iodide. The chemist was summoned, and his defence was that the prescription was accurately prepared. The reserve sample was referred to the Government Chemists, who reported that the sample contained iodine in the proportion of 92·4 grains, and potassium iodide 103·8 grains per 3 fluid oz. (The figures, it will be noticed, are considerably in excess of the quantities prescribed.) The certificate suggested

that the iodine had not been fully dissolved before the solution was divided, so that the three parts were unequal in strength. On that ground the magistrate dismissed the summons. (*C. and D., 18th. April, 1896.*)

The medical officer of health for Fulham wrote the following prescription, which was taken to most of the chemists in the neighbourhood to be dispensed:—

"Potassii iodidi,	- -	ʒ iv.
Syr. aurantii,	- -	℥j
Aq. ad,	- - -	℥vj.
M. Ft. mist."		

Several of the dispensers were summoned, under Section 7 of the Act of 1875. In one case the potassium iodide was stated to be 16 grains in excess. Dr. Attfield found only 2 grains in excess. The magistrate dismissed the case, as he was not satisfied on the evidence that the trifling amount over the prescription mattered in the slightest, and Section 7 should be read in the light of the preceding and succeeding lines of the Act. (*C. and D., 14th. October, 1899.*)

Glycerin.—A Birmingham chemist was summoned and convicted for selling 1d. bottles of glycerin which was certified by the analyst to be adulterated with 45 per cent. of glucose syrup. (*C. and D., 27th. February, 1897.*)

There have been a few prosecutions for selling glycerin containing small percentages of water. In

one such case the analyst certified to 9 per cent. of water. The reserve sample was sent to the Government chemists, who reported that the specific gravity at 60° Fahr. was 1·2492, and as the British Pharmacopœia standard was 1·25, they were of opinion that the sample contained no excess of water. The summons was dismissed with costs. (*C. and D., 10th. April, 1897.*)

Glycerin and Lime-juice.—There are a number of preparations for the hair to which this generic name is applied. Neither lime-juice nor glycerin is a very suitable component of a hair-wash or lotion, and if a mixture were made of the two it would in practice be unusable for such a purpose. Nevertheless these preparations have a certain vogue, and the public well know the kind of article they in fact require when they ask for a hair-wash by this name. The actual preparations are mostly oils and lime-water, with a little glycerin and some perfume. No doubt the term lime-juice has been applied as a misnomer for lime-water. Chemists as a whole would probably prefer the use of some name which was not so incorrect as lime-juice, but the public have acquired the habit of asking for the particular preparation they require under this name. There have been a number of prosecutions for the sale of this article, without any glycerin being present, and in many cases convictions have followed. The following is one of the most important, and was heard at Brentford. The defendant deposed that his formula was—

that the iodine had not been fully dissolved before the solution was divided, so that the three parts were unequal in strength. On that ground the magistrate dismissed the summons. (*C. and D., 18th. April, 1896.*)

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Nut oil, ...	4 oz.
Lime-water, ...	4 oz.
Saccharated lime solution, ...	40 drops.
Perfume (lemon and bergamot oils),	25 drops.
Glycerin, ...	½ dram.

It was sold as "lime-cream and glycerin," and the analyst certified absence of glycerin. (*Note.*—The preferable word *lime-cream* is substituted for lime-*juice*.) The reserve sample was referred to the Government chemists, whose analysis confirmed the defendant's statement. The hearing was adjourned, and Mr. Richard Bannister, then of the Government Laboratory, described his process of analysis, and admitted that he was assisted in arriving at his declaration about the preparation containing ½ dram of glycerin in 8 oz. by the report in the *Chemist and Druggist*. It also transpired that the reserve sample was the lower portion of the bottle, so that it would contain more glycerin than the other parts. The magistrates took the latter fact as the basis for dismissing the summons. *(C. and D., 27th. March, 24th. April, and 15th. May, 1897.)*

It is curious that in the cases quoted the defence was not advanced that the preparation is not a drug at all.

Gregory's Powder.—Dr. Gregory's original formula was:—Powdered rhubarb, 2 parts; powdered ginger, 1 part; light magnesia, 6 parts; mix. Magnesia is the oxide of the metal, and readily absorbs both water and

carbon dioxide gas from the atmosphere: the latter converts the oxide into the carbonate. In one case a chemist for the defence stated that he found Gregory's powder to absorb 14 per cent. of carbon dioxide and water in three days. *(C. and D., 15th. October, 1898.)* For further experimental evidence in proof of this absorption see a paper by *Umney (C. and D., 24th. September, 1898).* In cases brought before the magistrates their decisions seem about equally divided. Thus, the Guildford Bench *Held,* after hearing medical evidence, that the sale of Gregory's powder made with magnesium carbonate was not to the prejudice of the purchaser. *(C. and D., 23rd. and 30th. October, 1897.)* A London chemist was summoned for selling Gregory's powder composed of rhubarb and ginger 33·16, carbonate of magnesia 32·41, and light magnesia 34·43 per cent. The defence was that the powder was made with light magnesia solely, and that the "carbonate" certified was due to absorption of moisture and carbon dioxide from the air. The magistrate convicted. *(C. and D., 27th. August, 1898.)*

Olive Oil.—This is one of the articles on the border line, which may be used either in the arts or as a drug. A chemist sold as "pure olive oil" an article which he bought at 3s. 6d. per gallon. It was cotton-seed oil. He was convicted, the magistrate remarking, "People going to a chemist's shop ought to be able to get a pure article, as their purchases are frequently required for medicinal purposes." *(C. and D., 13th. October, 1888.)*

A Battersea shopkeeper sold olive oil containing 80 per cent. of seed oil. The prosecution was taken on the ground that olive oil is both a food and a drug. The defence was that it is neither; that the purchaser should have stated when he asked for the oil what he wanted it for. The magistrate strongly supported the view taken by the defence, and in giving judgment said that the oil was used also for machinery, and clearly when so employed did not come within the Act. *(C. and D., 20th. October, 1894.)*

Salad Oil.—An inspector bought a pint of salad oil from a chemist. Cotton seed oil was supplied and labelled "Columba Salad Oil." The chemist was summoned, and pleaded in defence that he asked the purchaser if he wanted olive oil, but the inspector indicated the kind which he got. The Bench dismissed the case, saying that the purchaser would have got olive oil if he had asked for it. (*C. and D., 11th. July, 1891.*)

Spirit of Nitrous Ether and Sweet Spirit of Nitre.—By the British Pharmacopœia of 1893, sweet spirit of nitre is made a synonym for spirit of nitrous ether. This substance is exceedingly volatile, and hence there is a difficulty, amounting in practice almost to an impossibility, in keeping the substance up to full strength. Nevertheless, spirit of nitrous ether has frequently been the subject of prosecutions. Thus at Ashton-under-Lyne a chemist sold as spirit of nitrous

ether a spirit which was a sixth of the minimum pharmacopœia strength. For the defence, evidence was called to prove the extreme difficulty of keeping the spirit, and that the deficiency was the result of natural deterioration. The Bench decided that the purchaser had not been prejudiced, as "there was no admixture and no attempt at cheating in any way." (*C. and D., 10th. March, 1888.*) In a prosecution of a company an interesting and successful defence was that the divided sample was put into bottles so large that the sample deteriorated below the minimum standard between the time of purchase and analysis. (*C. and D., 1st. April, 1899.*)

Beeswax.—In *Fowle v. Fowle* the respondent sold some beeswax which on analysis was found to contain about 50 parts of beeswax and 50 parts of paraffin. The justices found that beeswax is not a drug within the meaning of the Act, and dismissed the information. On appeal, GRANTHAM, J., said that, speaking for himself, he could "not admit that beeswax was a drug. . . . Everyone could think of instances where beeswax was used not as a drug. It was sold by a grocer at a little country shop. The grocer did not make it. He said he did not know what its constituents were. The justices were right." WRIGHT, J., concurred. The appeal was dismissed. (1896) 13, Times, L.R. 12.

Importance was evidently here attached by the Court to the kind of person from whom the beeswax was bought. Given a substance which is commonly

used both as a drug and for some other purpose, *e.g.*, castor oil: if bought from a chemist, the presumption is that it is to be used as a drug; but if bought by the gallon from an oilman it is probably intended for lubricating or other purposes in the arts.

CHAPTER IV.

USE OR NON-USE OF NEW MANUFACTURING PROCESSES.

New Manufacturing Processes.—These are being continually invented and applied to existing industries. The attitude of public analysts toward such new departures has been much divided. In some cases they have strongly insisted on their immediate employment, and have regarded their non-adoption as a criminal matter. In others they have just as strenuously opposed the introduction of the new invention, and have advised legal proceedings against those who are using the same. Their view in each case has evidently been governed by their opinion as to whether the new process tells in favour of purer and better articles of food or the reverse. Examples follow of such support and opposition respectively.

Starch in Yeast.—Yeast has long been used for the fermentation of bread, and for that purpose is usually obtained from either the brewer or distiller, of whose manufactures it is a bye-product. The yeast is skimmed or otherwise removed from off the top of

the fermenting vessels and set aside for sale. As thus obtained, yeast is a more or less sirupy liquid, consisting of minute cells of yeast suspended in water. In the earlier half of the last century this was the common and only known form of commercial yeast. At a later period it occurred to some continental distillers that if they could prepare their yeast in a solid condition there would be an extensive market for what was in the immediate locality of its production practically a waste product. But yeast as then manufactured was a very slimy body, and this rendered its separation from water by filtration extremely difficult. Ultimately the plan was adopted of mixing in starch with the yeasty fluid and then filtering off the water. The starch, as a result of its granular, porous nature, overcame the sliminess of the yeast, and the result was the production of a solid cake consisting of a mixture of starch and yeast. Not only was the yeast thus rendered portable, but its keeping qualities were improved, and a large trade was done in this "compressed" yeast over the greater part of Europe. Weight for weight, of course, compressed yeast contained many times more yeast cells than the old liquid yeast, and was proportionately more effective as a fermentative agent. But as first prepared, and during a considerable period of the history of its manufacture, compressed yeast was universally and invariably a mixture of yeast and starch. The proportion of starch present varied for different reasons. In some districts a very light-

coloured yeast was desired, and to meet this demand a larger proportion of starch was used. Some manufacturers were more capable than others, and could succeed in filtering their yeast with the addition of less starch. Others, no doubt, found that starch was cheaper than yeast, and loaded up their product with starch, not for the purpose of better filtration, but simply to fraudulently increase its weight.

Early in the 'seventies Pasteur commenced his classical researches on fermentation; and one of the first results was the discovery that, when brewers' and distillers' saccharine liquids (worts) were allowed to ferment, what went on was the life growth and development not only of yeast but also of foreign ferments or *bacteria.* Side by side with the growing yeast was a whole assemblage of bacterial weeds, hindering and choking the growth of the true yeast, and forming deleterious products. Efforts were made to free the yeast from these *bacteria*, and both brewers and distillers succeeded in obtaining and working with a much purer yeast. Now one of the characteristics of some *bacteria* is the formation of slime, and to this the sliminess of ordinary yeast was largely due. With this improvement in bacteriological purity, the yeast became much more easy to filter. In consequence, some of the more advanced manufacturers found themselves able to make a compressed yeast without any addition of starch at all. They were not able to press the yeast quite so dry, but nevertheless had the advantage of being able to adver-

tise it as "pure yeast." For some time pure and mixed yeasts were in the market together; but gradually the mixed was ousted by the pure, until now, in this country at least, there is little if any mixed yeast sold. At the time when both were being offered, the mixed yeasts attracted the attention of those responsible for the administration of the Food and Drugs Acts, and there was a number of prosecutions for selling yeast adulterated with starch.

The following is the history of a case which occurred in South Wales in 1894. A local vendor, whose trade was with small outlying villages and farms among the hills, had a sample of his yeast taken and analysed. It was found to contain starch, and he was warned by the local authorities. He communicated with the London dealer from whom he obtained the yeast, and the latter undertook to supply him with starch-free yeast at the same price. But the keeping properties of this yeast were not so good, and some of his customers who bought yeast only once a week complained that it went bad before they could use it. He fell back once more on the mixed yeast, and found it to satisfy his customers. As a result, the yeast was again analysed, and this time a prosecution followed, the charge being that he had sold yeast which was adulterated with starch to the extent of 20 per cent. For the defence, the facts already mentioned were proved, and chemical evidence was called to the effect that samples of the same manufacturer's yeast, unmixed and mixed, had respectively the following composition:—

	Unmixed.	Mixed.
Starch, ...	0·00 per cent.	19·20 per cent.
Water, ...	72·88 ,,	60·40 ,,

The unmixed yeast therefore contained 12.48 per cent. more water than the mixed sample, which latter contained 19.20 per cent. of starch. Of this starch, therefore, 12·48 per cent. simply replaced water, leaving a surplus of 6·72 per cent. of starch, which had gone to increase the weight. A test was made of the gas evolving power of the two yeasts, with the result that the unmixed sample yielded 440, and the mixed sample 443 volumes of gas in four hours. Following the case of *James v. Jones*, 1894, 1 Q B., 304, in which baking powder was held not to be an article of food, the point was raised that yeast also did not fall within the definition of food contained in the Act. Ultimately the magistrate held himself bound by that decision, and dismissed the case.

There was, however, a considerable number of prosecutions, followed in many cases by convictions, the ground apparently being that the addition of starch was not a necessity. The point of interest is that about this time a development occurred in yeast manufacture, the consequence of which was that what had been a necessity ceased to be one as the result of the application of improved methods.

Improvements in Vinegar Manufacture.—It was for a long time found that the presence of certain

natural products of manufacture in vinegar, namely, phosphoric acid and albuminoids (proteids) very much impaired the keeping properties of vinegar. In consequence, vinegar brewers devised methods of removing these objectionable bodies. This treatment of vinegar became the subject of discussion at a meeting of the Society of Public Analysts. Widely divergent views were expressed, both sides being represented in the following opinions of high chemical authorities:—

Hehner "Wished to protest against the removal of phosphoric acid or albuminoids from vinegar, and thought that the manufacturer had absolutely no right to effect such a removal. The removal was prejudicial to the purchaser. . . . Here again he was of opinion that the long-recognised and legitimate modes of manufacture should be adhered to, and the introduction of chemical meddling with food materials resisted. It should not be left to the discretion of the manufacturer of articles of food to say which constituents were valuable and essential and which were not, and in no case should such removal be effected without due notice to the purchaser."

Allen "entirely disagreed with Mr. Hehner that a vinegar manufacturer was not at liberty to remove things prejudicial to vinegar. It was in his opinion the manufacturer's business to make good vinegar, and, so long as he sold it for what it was, he was at perfect liberty to remove any objectionable constituents which impaired its keeping qualities." (*XIX. Analyst, 48.*)

It is only fair to remember that the manufacture of inegar, in common with that of most other commodities, has been slowly progressive in its developments, as the result of the application of improvements devised by the manufacturers themselves. It would therefore seem scarcely logical to step in at any moment and say vinegar shall consist of a body made by the methods so far devised and gradually adopted by the makers; but they, the manufacturers, shall not be permitted to employ any further improvements they may invent or discover.

What is Whiskey?—In November, 1905, there were prosecutions by the *Islington Borough Council* of *Wells* and of *Davidge* for selling, as "Irish Whiskey" and "Scotch Whiskey" respectively, articles which were in fact neither Irish nor Scotch whiskey. By arrangement the two cases were taken together. The public analyst, Dr. Teed, was called, and defined whiskey in the terms—"Whiskey should consist of spirit distilled in a pot-still derived from malted barley mixed or not with unmalted barley and wheat or either of them." Whiskey, in common with other potable spirits, consists essentially of ordinary or ethyl alcohol; admixed with which are more or less "impurities" or "secondary products" which impart to the spirit its typical flavour and character. It was further explained that spirits may be distilled in stills of two different types. The older of these is known as the pot-still, and is a comparatively primitive

appliance. A species of kettle has a pipe leading away from its upper or steam space, which communicates with a worm or spiral of metal tubing enclosed in a vessel of cold water. On heating the kettle or pot, the steam from the contained liquid passed over into the worm and was condensed once more to the liquid form. The whole object of this apparatus was to separate bodies which boiled at a lower temperature from those which boiled at a higher, and *a fortiori* from those which did not boil at all, being solid. The separation is, however, imperfect, for if between two bodies thus mixed there is only a comparatively small difference in the boiling point, that which is most volatile will distil over first, but it will be accompanied by some portion of the less volatile substance. Thus when a fermented mixture containing alcohol and water is put in the still, the spirit which distils over consists not only of alcohol, but also of accompanying water. These are the primary products, but the spirit also contains those bodies which are more volatile than alcohol. In addition, more or less of compounds of even higher boiling temperature than water are carried over and condensed with the spirit. These latter bodies constitute the impurities or secondary products before referred to. The proportion of secondary products found in the yield of the pot-still is higher than is deemed desirable. Accordingly some portion of these is removed by the employment of one or more of the following methods:—re-distillation, some modification

of the form of the still, or the use of absorbent chemicals. The alterations in the form of the still take the shape of introducing a length of condensing surface between the still and the condenser, at such an angle that any liquid which condenses "returns" again into the pot. Naturally the least volatile bodies thus condense first, and, by running back, cause the spirit which does come over to be less charged with such substances. The spirit thus produced contains comparatively large proportions of secondary products, and in flavour and general properties is greatly affected by the nature and character of the grain used in preparing the fermented mash put into the still. In new pot-still spirit, the secondary products are of such a nature as to render the spirit at first practically undrinkable. It is accordingly stored and allowed to mature in oak casks, and after the lapse of years the secondary products become so modified as to impart the delicate flavour and aroma to the spirit recognised as those of "old whiskey."

The other form of still mentioned was that known as the Patent or "Coffey" still from the name of the patentees, by whom it was invented about 1831. The patent still is a somewhat intricate contrivance, but the essential principle is the full utilisation of the principle of return condensation. The less volatile of the rising vaporised bodies are continually being condensed and returned to the body of the still. In this way a much more complete separation of bodies of different degrees of volatility is possible than with

the pot-still. This separation, it is asserted, may be carried so far as to produce an alcohol so devoid of secondary products as to be termed "silent" spirit. Such spirit, bar more or less water, is practically pure ethyl alcohol. Since the 'seventies of last century the patent still has been used for the manufacture of spirit to be sold as whiskey. The spirit thus produced contains a lower proportion of secondary products than pot-still spirit, and apparently can be used with a wider range of grains and yet produce a spirit of a whiskey character.

Teed examined 38 samples of pot-still spirit and found a minimum of 378·3 parts of impurities or secondary products per 100,000 of absolute alcohol. From this he took the figure of 380 parts per 100,000 as the lowest most convenient figure for calculation. He also examined 11 samples of patent still spirit, and found the maximum of impurities to be 203·8 parts per 100,000 of absolute alcohol. In the Irish whiskey the subject of the prosecution 174·5 parts of secondary products per 100,000 were obtained on analysis, and in the Scotch whiskey 110·5 parts. On these data the analyst regarded both whiskeys as being entirely patent still spirits and containing no pot-still spirit. The defendants alleged that the whiskeys sold by each of them respectively as Irish and Scotch whiskeys consisted of 10 per cent. pot-still and 90 per cent. patent still spirits.

Prior to 1870, whiskey was apparently mostly produced in a pot-still, and a full-flavoured spirit

requiring age for its proper maturation was the result. The consensus of London opinion seems to have been that such spirit was too full flavoured for local tastes. Subsequent to 1870, patent still whiskeys of a milder character have been made and sold either separately or blended with pot-still. Simultaneously with this supply of a milder whiskey, the popular taste for whiskey in London has materially developed. The point for decision by the magistrate was whether or not this mild whiskey produced in whole or in part in the patent still and from a range of grains wider than that included in Teed's definition, is entitled to be sold as Scotch or Irish whiskey respectively.

In the course of giving judgment the learned magistrate said—"Dr. Teed analysed the samples, and, after setting out the result of his analysis, certified as to each sample that it 'consists entirely of patent still, silent, or neutral spirit. Whiskey should contain a spirit distilled in a pot-still derived from malted barley, mixed or not with unmalted barley and wheat, or either of them. Such whiskey contains at least a co-efficient or total of the above-mentioned impurities of 380 parts per 100,000 fluid parts of absolute alcohol. Patent still spirit contains from 89 to 204 parts of total impurities with an average of 140 parts per 100,000 fluid parts of absolute alcohol.' To be clear, I will remark that the impurities here referred to are impurities chemically only, such as acidity, aldehydes, furfural, ethers, and higher alcohols."

"The contention of the Prosecution is that Irish and Scotch whiskey are different kinds of potable spirits, each made by a definite method from definite materials, and both containing definite chemical properties; that both Irish and Scotch whiskey must be the result of distillation in Ireland or Scotland respectively by the pot-still, derived from cereal grains indigenous to Ireland and Scotland. This cereal grain, the Prosecution contends, in the case of Irish whiskey must be chiefly malted barley, to which has been added smaller quantities of barley, wheat, oats, and rye, or any of them, and in the case of Scotch whiskey, malted barley alone. The Defendants, on the other hand, say, through Counsel, that Irish whiskey is a spirit distilled in Ireland from grain, and Scotch whiskey a spirit distilled in Scotland from grain. . . . The questions I have now to decide are . . . whether the fluids sold by the Defendants . . . were respectively Irish and Scotch whiskey. Before I can decide this I must find what is understood in this country by the word 'whiskey.' . . . Of the many witnesses called before me some say whiskey is the produce of the pot-still only. None say that it is the produce of the patent still only. Some say it may be made either by the pot or by the patent still. All say it can only be made from grain, but they do not all agree as to the kind of grain. 'Whiskey,' I have no doubt, is a word derived a century or so ago from the word 'Usquebaugh,' which signifies a spirit distilled in a form of pot-still in Ireland or Scotland

from grain grown and generally malted in Ireland or Scotland. Until some 45 years ago, all that which was drunk as whiskey was so made. Then the patent still came into use, and . . . to-day there is an immense output of patent still spirit made, with very few exceptions, from a mash composed largely of maize. . . . That part of the output of the patent still which is consumed in this country by the public is not generally sold to them alone, but mixed with more or less of pot-still spirit, and then it is sold as whiskey. The evidence given before me does not satisfy me that the public generally does now, or ever has, accepted the product of the patent still alone as whiskey—certainly not when maize is used. . . . Though I find that the patent still spirit alone is not whiskey, there is evidence before me that when mixed with a considerable proportion of pot-still spirit, or whiskey derived from malted barley, such mixture has long been sold to, and accepted by, the public in immense and increasing quantities as whiskey. . . . Whether I should hold such mixtures to be whiskey or not, I am not called upon to say, and I express no opinion as to that. . . . In both Ireland and Scotland from earliest times . . . whiskey has been distilled by pot-stills. It certainly was so made when it was first known as Irish whiskey and Scotch whiskey, and I must hold that, to be Irish and Scotch whiskey now, the spirit must be obtained in the same methods by the aid of the form of still known as the pot-still. The produce of the patent still, unmixed with pot-

still whiskey, cannot be Irish or Scotch whiskey, although made in Ireland or Scotland. The patent still is not used to obtain spirit by the method known as Irish and Scotch. As to the material to be used to produce Irish or Scotch whiskey, it must be such as has been always used in the Irish and Scotch form of still respectively. This I find from the evidence I have heard is, in Irish whiskey, barley malt, as to about 75 per cent., and as to the rest of the mash, barley, wheat, oats, and rye, or any of them ; and in Scotch whiskey it is wholly barley malt." . . .

"On the evidence I heard, I find that what Wells and Davidge sold as "Irish" and "Scotch" whiskey respectively was patent still spirit, made largely from maize, to which had been added a dash—not 10 per cent.—*of Irish or Scotch whiskey. . . . I find* the sales . . . were both to the prejudice of the purchaser. . . . The defendants . . . will each pay a fine of 20s. and costs."

The defendants appealed against the conviction to the Clerkenwell Sessions. At the hearing the justices were equally divided, and the conviction stood. The matter was thus left in a condition of uncertainty, which was the reverse of satisfactory to all parties. Accordingly in February, 1908, a Royal Commission was appointed to investigate the question generally as to what meaning should properly be attached to the word "whiskey." The following were the principal terms of reference :—

"The terms of reference are: to inquire and report—

1. Whether in the *general interest of the consumer*, or in the interest of the public health, or otherwise, it is desirable

(*a*) To place restrictions upon the materials or the processes which may be used in the manufacture or preparation in the United Kingdom of Scotch whiskey, Irish whiskey, or any spirit to which the term whiskey may be applied as a trade description;

(*b*) To require declarations to be made as to the materials, processes of manufacture or preparation, or age of any such spirit."

The Commission held a number of sittings and heard evidence, from the advocates for the prosecution and defence in the Islington whiskey prosecutions, as to the general nature of those cases and the points at issue therein. Evidence was also given by distinguished chemists, whiskey distillers, blenders and vendors, and members of the public as representing the purchasing community.

In due course the Commission submitted an interim report, which on the 16th July, 1908, was issued as a parliamentary paper. Of this report, the following is an extract:—

"We have held 22 sittings, and examined 74 witnesses. Certain of the Commissioners have visited distilleries in Scotland and Ireland, and have thereby obtained much valuable information.

Whilst the labours of the Commissioners are by no means terminated, we have arrived at certain conclusions, which we now humbly submit to Your Majesty as follows:—

1. That no restrictions should be placed upon the processes of, or apparatus used in, the distillation of any spirit to which the term "whiskey" may be applied as a trade description.

2. That the term "whiskey," having been recognised in the past as applicable to a potable spirit manufactured from (1) malt, or (2) malt and unmalted barley or other cereals, the application of the term "whiskey" should not be denied to the product manufactured from such materials. We reserve for further consideration the question of the advisability or otherwise of attaching special significance to particular designations, such as "Scotch whiskey," "Irish whiskey," "grain whiskey," and "malt whiskey"; of placing restrictions upon the use of such designations as trade descriptions; or of requiring such designations to be used in connection with the sale of whiskey."

In the learned magistrate's judgment in the cases of Wells and Davidge two most important decisions were given. In the first place, whiskey can only be made in the pot-still. Secondly, the material used must be for Irish whiskey about 75 per cent. of barley malt, and as to the rest, barley, wheat, oats, and rye or any of them; and for Scotch whiskey, barley malt only.

The first recommendation of the Royal Commission is that no restriction should be placed on the processes or apparatus used in the manufacture of whiskey. The patent still is therefore equally admissible with the pot-still. The second is that whiskey may be made from malt and unmalted barley or other cereals, thus including maize and rice as well as indigenous grains. In effect the Royal Commission reverses the judgment of the magistrate in these whiskey cases.

It may be pointed out that the pot-still was first used for the distillation of whiskey, not as the result of any magical and inherent virtues it possessed, but simply because it was the only kind of still known at that time. Further, the cereals employed were those indigenous to the country, not in consequence of these being purer or producing a better spirit than rice or maize, but simply for the reason that they were the only ones commercially available.

The materials of which an article of food may be prepared is a debateable question, which in each instance must be decided on its merits. No one would now allege, for example, that bread would be adulterated if the wheaten flour from which it was made had been of foreign origin. Yet at one time English bread was made from English wheat only, and the logical conclusion following from the whiskey judgment would be to regard the use of foreign flour as an adulteration. The restriction on the use of new apparatus is in a different category. In every industry inventions and improvements in manufacturing

appliances are continually being made. The Prosecution sought to lay down that whiskey must be made in a pot-still, and may not be made in a patent still. By the same rule butter would have to be made by hand, and could not be made in a modern mechanical churn. It is a matter for congratulation that these contentions were ultimately unsuccessful, else old processes would have been stereotyped, and the use of improved inventions regarded as a crime.

CHAPTER V.

USE OF PRESERVATIVES AND COLOURING MATTERS.

Diversity of Opinion.—Even among the highest authorities great differences of opinion exist as to the permissibility or otherwise of the use of preservatives and colouring matters in articles of food. In view of the great importance of the subject, it is proposed to discuss the matter somewhat fully.

Statutory Enactments.—The Sale of Food and Drugs Act, 1875, makes no specific mention of preservatives, but colouring matters injurious to health are prohibited by section 3. There remains only the question of whether the use of these substances may be regarded as constituting an offence under any of the other sections of the Act (see page 18). That is to say, is such an addition to the prejudice of the purchaser, is it injurious to health, is it necessary, or is it fraudulent? The answer to these questions in each particular case must decide whether an offence has been committed.

Those sections of the Act of 1899 which are essentially amending sections of that of 1875 are silent as to the use of these substances; but among the sections

which are new and additional legislation is the first, which deals with "Precautions against importation of agricultural and other produce insufficiently marked." Such marking must, among other things, conspicuously indicate that any adulterated article has been so treated. Adulteration is defined in section 1, sub-section 7, as follows:—

> "For the purposes of this section an article of food shall be deemed to be adulterated . . . if it has been mixed with any other substance . . . so as . . . to affect injuriously its quality, substance, or nature.
>
> "Provided that an article of food shall not be deemed to be adulterated by reason only of the addition of any preservative or colouring matter of such a nature and in such quantity as not to render the article injurious to health."

It is here very clearly laid down that for the purposes of this section, the addition of preservatives and colouring matter is permitted subject only to such addition not being injurious to health. This principle being recognised in this particular case, its guidance may be of assistance in interpreting other sections of the Acts.

Decomposition of Articles of Food.—Most articles of food are perishable in their natural state; it is therefore necessary that they be eaten while fresh, or that certain means be taken of preserving them. It

is now well known that decomposition and putrefactive changés are not spontaneous, but are largely due to the action of those forms of minute life known collectively as *bacteria*. In addition, there are various non-living organic substances, termed enzymes, which effect chemical changes in food compounds. As an example of these latter may be mentioned diastase, which possesses the property of converting starch into maltose (malt sugar) and dextrin. At low temperatures bacteria are either killed or have their functions suspended or retarded. The action of enzymes is also almost, if not completely, inhibited by cold; but enzymes being non-organised bodies, there is no question of their being killed by low temperatures. The methods of preservation by the use of cold storage are all of them based on this fact that cold suspends or retards the action of agents of decomposition and putrefaction. Such degree of cold as is now generally used does not destroy bacteria. If they are present, therefore, their action proceeds as before on a rise of temperature; and equally the food is just as liable to decomposition if subsequently attacked by extraneous *bacteria*. Refrigeration or cold storage is, where applicable, probably the best method of food preservation possible. It adds no foreign matter to the article thus preserved; and on raising the temperature to the normal the food is practically unchanged in so far as its susceptibility to digestive action is concerned.

Another method of food preservation consists in subjecting it to the action of heat. Bacteria are thereby

completely destroyed, and enzymes are also so altered as to entirely lose their power of effecting the changer characteristic of their action. Tinned milk and meats are preserved in this way: the food is, however, cooked, and certain other permanent changes are also caused. On being again exposed to the action of bacteria, such heat-preserved foods are subject to putrefaction as before. Again, where heat preservation is applicable, there is comparatively little objection to its use.

Other methods of preservation consist in adding, to the food, substances which either destroy bacteria or suspend or retard their putrefactive functions. For this purpose, mercuric chloride is one of the most potent agents for complete destruction known; but it is also one of the most deadly poisons in existence. Mercuric chloride is therefore absolutely unsuitable for use as a preservative, which as a first condition must as employed be certainly harmless to human life. There are many substances which possess a preservative action without being markedly poisonous. But it is necessary to go a step further—such substances should not have any marked therapeutic action in the quantities used. Further, digestive processes are effected by agents analogous to those causing putrefactive and similar changes—*i.e.*, by enzymes such as ptyalin and others which convert starch into sugars, and bacteria which fulfil important functions in the digestive tract. If any preservatives, used to destroy or retard those agents producing putrefactive changes in food, also act similarly and with equal energy in the alimentary

canal, they may upset and disorganise the whole process of digestion. The ideal preservative should perfectly inhibit all decomposition of food, and yet be absolutely harmless in all the ways just indicated when taken into the human body.

So many articles of food are perishable, that by general consent certain substances may be used to preserve them; among these are salt in foods and alcohol in beverages. Widely different views are held as to the admissibility of other and more modern preservatives. Thus, to quote Lauder Brunton, "One must remember that poisons are formed in foods by spontaneous decomposition, *which may take place after purchase.* The question to be decided comes to be whether antiseptics are likely to be more injurious to health than the natural products of decomposition. His own belief is that the preservatives are the less injurious." He further says "(1) The use of antiseptics should not be forbidden by law. (2) It is doubtful whether legislation should restrict the amount, as the makers will probably use the minimum amount found sufficient. (3) The fact of preservatives being used, and their amount, should be stated on the label." *Lancet, 1897, p. 56.*

Another view is presented by Hehner—"If preservation could not be effected without the addition of some foreign material, the benefit to mankind of preventing good food substances from decomposition would doubtless be greater than the slight physiological evil effect of the antiseptic itself. But, as

preservation of any article of food is possible without addition of chemicals, it seems to me that the time has come for public analysts generally to set their faces against the present practice of allowing the addition of any antiseptic which the dealer in food may choose to make." *Analyst, XV. 221.* And, again, "Granted that, in at least 99 per cent. of food, preservatives did no harm, the addition, being unnecessary, was illegal under the Sale of Food Act." *Ibid, 234.*

The latter expression of opinion was written before the passing of the Food and Drugs Act, 1899. Neither of the processes of heating or refrigeration is effective against Brunton's apprehension of poisonous changes taking place spontaneously after purchase, while chemical preservatives properly used are continuous in their action and do prevent such changes.

Properties of Permitted Preservatives.—Among these, salt and alcohol have been already mentioned. Others of the group are saltpetre (potassium nitrate), vinegar, wood-smoke, and sugar. The following descriptions of these preservations are given principally on the authority of *Thresh and Porter on Preservatives in Food* (This source is indicated by the initial letters, *T. and P.*, and the page). *Salt* is the oldest preservative known. Butter has been known to contain as much as 15 per cent. (*Allen's Commercial Organic Analysis, Vol. II., p. 150.*) Now, mild butters contain only 2 per cent. The difference in this extreme case is a gain of 13 per cent. in true butter constituents. Salt has

the disadvantage that large quantities are necessary to be effective. These "produce ill effects, [it] is contra-indicated in certain diseased conditions, and may render food less amenable to digestive processes." (*T. and P., p. 13.*)

It is claimed that the salt used for preserving purposes serves also as an article of food, and therefore is in a different category altogether to other preservatives. Hutchison can scarcely be said to support this theory—"Of common salt most people consume about 20 grams daily, which is probably at least ten times as much as is really necessary to meet the needs of the body. . . . It may be admitted—for the experience of those who refuse to add any salt to their food amply proves it—that the amount of salt contained in a natural form in ordinary foods is quite sufficient for our needs; but there is no proof that an extra addition of salt in the form of a condiment is in any way injurious to health. On the other hand, it is equally far from being proved that such addition conduces in any way to the well-being of the body." (*Food and Dietetics, p. 282.*)

Saltpetre is largely used in salted meats, *e.g.*, hams, &c. It has the power of inducing inflammation of mucous membranes, and renders meat more difficult of digestion in the stomach. "It is fairly obvious, however, that if long custom had not sanctioned the use of this drug as a preservative, such use would be strongly condemned by those who have the supervision of the purity of our food supplies." (*T. and P., p. 15.*)

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Vinegar "used in moderation is . . . not likely to produce injurious consequences; nevertheless, if it were not one of the oldest preservatives in use, objections would be raised to its introduction . . . and its use probably condemned." (*T. and P., p. 93.*)

Smoke from smouldering wood or sawdust, and *crude pyroligneous acid* obtained by the destructive distillation of wood, are both used as meat and fish preservatives. In smoke, "creosote is probably one of the active antiseptic agents. It is a very poisonous substance, and doubtless a great outcry would be raised were anyone to attempt to use it for preserving food, but so long as it is introduced into the food in an old-fashioned manner no objections are raised. It is only when someone wishes to improve upon ancient methods that the effect of prejudice and conservatism makes itself felt. It has never been alleged, so far as we are aware, that smoked meat is unwholesome, though its digestibility is almost certainly impaired. Any modern system of preserving which affected the digestibility to a similar degree would be strongly condemned." (*T. and P., p. 9.*)

Again—"Had it [smoking] been a recent introduction there can be no doubt it would have been received with a howl of execration, and the evidence adduced of the poisonous nature of the antiseptic would have sufficed to put an end to the practice speedily." (*T. and P., p. 96.*)

Such are the conclusions of two of the highest authorities on recognised and admitted preservatives.

New Preservatives.—With the progress of scientific knowledge, new preservatives have been discovered. Among these are *Boric acid* and its compounds. Their *advantages* are that smaller quantities are efficient, and that they are tasteless in food. As the result of a series of tests made by the Limerick butter manufacturers, they found that one per cent. of boric acid preservative kept butter good for nine months; whereas with six per cent. of salt the butter was uneatable and rancid at the end of that time. (*T. and P., p. 19.*)

Alleged disadvantages.—"Boric acid is foreign to the human body;"—but it shares this property with saltpetre, vinegar, smoke, and even cane sugar. "Boric acid retards certain processes of digestion;"—but it shares this property with salt and saltpetre. "Boric acid produces distinct therapeutic effects." Tunnicliffe made a series of experiments on three children, aged from 2½ to 5 years. Boric acid was administered to them for three weeks. The final conclusion was that "Neither boric acid nor borax in any way affected the general health and well-being of the children." (*T. and P., p. 38.*)

The author suggests, as a true test, a comparison of boric acid, as the newer substance, with common salt, the accepted preservative. Given a certain quantity of salt necessary for preservation, is the quantity of boric acid necessary for the same degree of preservation any more injurious to health than the required quantity of salt? To this question no answer in the affirmative seems yet to have been given.

Preservatives in Beverages.—Like other articles of food, beverages, unless used immediately after preparation, require to be subjected to some process of preservation. In wines and beers, alcohol is present in considerable quantity.

Alcohol.—It is there recognised as a natural preservative, and no question of adulteration arises on its use. In composition, wine is a liquid containing in solution, sugar, dextrinous matters, organic acids, ethers, and alcohol. To prevent decomposition of the unstable bodies, a minimum quantity of 5 per cent. of alcohol is stated to be required in still wines, and a lesser quantity in sparkling wines. Wine is said to be made of almost anything, sometimes even of grapes. At any rate, there are certain wines known as British wines. These are avowedly sold as manufactured imitations of port and other grape wines, and consist of sugar, dextrinous matters, organic acids, and flavouring matters. To give character to these, and to preserve them, alcohol is added. However strongly fortified, no proceedings are ever taken under the Adulteration Acts on the ground that alcohol is injurious to health.

Notwithstanding this legislative inaction, the Total Abstinence section of the community regard alcohol as the most insidious and dangerous poison known. Apart from the extreme view, there is a general consensus of opinion that anything beyond a very moderate use of alcoholic beverages causes most serious injury to health. The natural result is a less consumption of beverages of the alcoholic type and an increased demand for non-

alcoholic beverages, both from total abstainers and also other sections of the community.

The popular forms of such beverages contain, as their fundamental ingredients, the same class of bodies as wine, but *minus alcohol.* The result is a beverage containing a group of unstable bodies without alcohol as a preservative agent. Manufacturers generally find that they require to use some substitute for the alcohol. One most frequently adopted is salicylic acid, traces of which occur naturally in strawberries and almost every other variety of ordinary fruits. Methyl salicylate constitutes about 90 per cent. of oil of wintergreen, an essential oil used in beverages and confectionery. Salicylic acid is therefore a natural product, entering widely, though in minute quantities, into natural and artificially-prepared articles of food. It may be introduced in beverages either as a component of a fruit constituent or as a natural essence for flavouring purposes.

Salicylic acid is prepared synthetically; the earlier product, contained injurious impurities, which now, however, are practically eliminated in manufacture. Pure salicylic acid is, however, a powerful drug, and its use has been strongly objected to. The subject has been investigated by McAlister and Bradshaw, who say that salicylic acid is alleged to be injurious on three grounds:—

1. It is liable to destroy digestive ferments. To this they *reply*—A saturated solution of the acid retards artificial gastric digestion only to the same extent as a

solution of common salt of equal strength, and not at all digestion of starch in alkaline solution of pancreatic juice.

2. After absorption it interferes with nutrition. *Reply*—The investigators made personal experiments on selves and children: no ill effects were produced.

3. It is an irritant, and apt to injure the mucous membrane of the stomach and intestines. *Reply*—Pure salicylic acid is certainly not more harmful to epithelium than pure hydrochloric acid. The latter acid, diluted to the same extent (1 in 500) as a saturated solution of salicylic acid, is a constituent of normal gastric juice.

In temperance beverages "*some antiseptic is necessary.*" *Lancet, 14th. March, 1903.*

The question of injury to health is the most important consideration. Is the preservative more harmful than the alcohol for which it is used as a substitute? As in the case of boric acid against salt, there seems to be no affirmative answer given to this question.

Wiley's Researches. — Acting on behalf of the Government of the United States of America, Wiley has made a most extensive series of investigations as to the effect of preservatives on the health of the consumers. The opinions he has formed are directly opposed to any use of preservatives whatever. The case against such use has been presented most strongly by Wiley; and the following abstract of a paper read by him shows very clearly the conclusions at which he has arrived, and the reasons on which they are based:—

ABSTRACT OF

Influence of Preservatives and other substances added to Foods upon Health and Metabolism.

by HARVEY W. WILEY, M.D.,

Proc. Amer. Phil. Soc., Vol. XLVII., No. 189, page 302 May-August, 1908.

Preservatives and colouring matter are not condimental, but on the contrary possess neither appreciable taste nor odour in the quantities employed. Their use is quite of recent date. Thirty to forty years ago food supply was practically free from them. Their purpose is either to cheapen the product or to sell it at a higher price than it really should command.

In regard to the supposed preference for artificial colour, the great majority of American consumers prefer uncoloured foods. A test was made by supplying during the winter months, when natural butter is almost white, natural and coloured butter mounted in the same form and placed upon the same plate. In four or five months nine-tenths of the users were using uncoloured butter and expressed a decided antipathy to that which was coloured. The use of the artificial colour, therefore, is to simulate for winter butter the colour of the butter in June, and thus to conceal what is at least believed to be inferiority.

The real reason which manufacturers have for using chemical preservatives is to cheapen the cost

of production. Presumably this would lower the price to the consumer. If the food product were of equal nutritive value and equal wholesomeness, such a process should meet with the approbation of all. Chemical preservatives inhibit the fermentative action giving rise to decay and putrefaction, but have not the same restrictive influence on those processes resulting in the general degradation and decay of organic matter, due chiefly to that class of chemical reactions which is represented by the term hydrolysis. Those ferments which break down nitrogeneous tissues into more soluble and finally more dangerous forms of combination are not so particularly inhibited.

The most important problem is, what is the chief effect of these preservatives upon the health of those who constantly use them and upon the metabolism resulting from the normal functions of the body? The Bureau of Chemistry has systematically investigated this problem. A selected number of young men were dieted under certain precautions. During the first part of the experiment they had a generous diet of such articles of food as they preferred (within limits). Studies were made of the food ingested and of the excreta. Having established normal conditions of body, what was called the "fore period" was brought to a close. The "preservative period" then commenced, during which various preservatives, and in different quantities, were administered. The period lasted for from twenty to sixty days. The state of health, the gain or loss in weight, and other conditions were noted

and studied. Exhaustive analyses were made of ingesta and excreta. At the close of the preservative period came the "after period," during which the preservative was no longer used, but only the normal diet given. During this time the after effects, if any, of the preservative were studied.

The following preservatives were thus investigated:—Boric acid, borates, salicylic acid, salicylates, benzoic acid, benzoates, sulphurous acid, sulphites, formaldehyde, sulphate of copper, and potassium nitrate. [The desired quantity of each preservative was administered in the separate state, enclosed in a capsule with each meal.] The following medical and clinical notes were made of the effects of certain of these preservatives. Borax and boric acid—loss of appetite, nausea, headache, depression; salicylic acid and salicylates—hunger, slight headache and abdominal pain, symptoms not general; sulphurous acid and sodium sulphite—headache, dizziness, pain in stomach, weakness, depression; benzoic acid and benzoates—nausea, headache, lassitude; formaldehyde—headache, abdominal pains, sometimes nausea and rash; copper sulphate—pains in stomach and abdomen, nausea, indigestion, headache, nervousness; potassium nitrate—slight headache, pains in epigastrium.

The following are the summarised conclusions as to various preservatives:—

Boric acid and borates.—The administration of boric acid to the amount of 4 or 5 grams per day, or borax equivalent thereto continued for some time, results in

most cases in loss of appetite and inability to perform work of any kind. In many cases the person becomes ill and unfit for duty. The normal man cannot go beyond 4 grams per day, and could not long continue to receive 3 grams per day. . . . The administration of borax and boric acid to the extent of one-half gram per day yielded results markedly different from those obtained with larger quantities of the preservatives. On the whole, the results show that one-half gram per day is too much for the normal man to receive regularly. On the other hand, it is evident that the normal man can receive one-half gram per day of boric acid, or of borax expressed in terms of boric acid, for a limited period of time without much danger of impairment to health. It appears, therefore, that both boric acid and borax, when continually administered in small doses for a long period or when given in large quantities for a short period, create disturbances of appetite, of digestion, and of health.

Salicylic acid and salicylates.—There has been a general concensus of opinion among scientific men, including the medical profession, that salicylic acid and its compounds are very harmful substances, and the prejudice against this particular form of preservative is perhaps greater than against any other material used for preserving foods. This is due not only to the belief in the injurious character of salicylic acid, but perhaps is especially due to the fact that it has in the past been so generally used as

an antiseptic. That salicylic acid should be singled out especially for condemnation among preservatives does not seem to be justified by the data which are presented and discussed in this bulletin. That it is a harmful substance, however, seems to be well established by the data taken as a whole, but it appears to be a harmful substance of less virulence than has been generally supposed. In the light of the data which have been obtained, salicylic acid may be said to increase the solubility and absorption of the food in the alimentary canal, so that larger parts of the nutrients taken into the stomach actually enter the circulation. The same data also indicate that the general effect upon the system is depressing, in that the tissues are broken down more rapidly than they are built up, and thus the normal metabolic processes are interfered with in a harmful way. The final conclusion, therefore, is that the unenviable position which salicylic acid has heretofore held among preservatives, in being regarded as the most injurious of all, is to a certain extent undeserved. It has a tendency to diminish the weight of the body and to produce a feeling of discomfort and malaise, which, while not marked, is distinctively indicative of injury. In some cases these symptoms of malaise approach illness, and while not always diagnostic are sufficiently common to point unmistakably to the salicylic acid as their origin. It places upon the excretory organs, especially the kidneys, an additional burden which they are not able to bear, and which cannot possibly

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result in any good, but on the contrary must necessarily finally result in injury, though perhaps with the use of very small quantities of the preservative, these organs would continue to perform their function for many years before finally breaking down. An unbiassed study of all the data recorded leads to the inevitable conclusion that salicylic acid is a substance which, when added to food even in small quantities, exerts a depressing and harmful influence upon the digestion and health and the general metabolic activities of the body. Further, there appears to be no necessity for its use, as food can be preserved in unobjectionable ways without its aid. Its indiscriminate use would tend to carelessness in the quantities employed, thus increasing the dangers to which the consumer is subjected. Also, its use in the preservation of foods tend to induce carelessness and indifference on the part of the manufacturer, as when a chemical antiseptic is employed many of the processes necessary to the proper selection, cleaning, and preservation of foods may be omitted. The addition of salicylic acid and salicylates to foods is therefore a process which is reprehensible in every respect, and leads to injury to the consumer, which, though in many cases not easily measured, must finally be productive of great harm.

Sulphurous acid and sulphites.—The verdict which must be pronounced is decidedly unfavourable to the use of these preservatives in any quantity or for any period of time, and shows the desirability of avoiding

the addition of any form of sulphurous acid to products intended for human food.

Benzoic acid and benzoates.—The administration of benzoic acid, either as such or in the form of benzoate of soda, is highly objectionable and produces a very serious disturbance of the metabolic functions, attended with injury to digestion and health. There is only one conclusion to be drawn from the data, and that is that in the interests of health both benzoic acid and benzoate of soda should be excluded from food products.

Formaldehyde.—Apart from the injurious effects of formaldehyde itself, its use as a food preservative would be specially inadvisable in milk or cream, because its addition in dilute solution prevents the growth of acid-forming bacteria, but has no effect in retarding the action of many harmful organisms; in other words, the milk is prevented from becoming sour and thus indicating its age and the danger signal is thus removed, while the other organisms which are capable of producing disease continue to multiply in the milk with practically the same degree of rapidity as if the formaldehyde was not present. Formaldehyde causes a uniformly increased absorption of the proteid elements of the food, which would lead one to expect a gain in the body weight. This expectation, however, is not realised, although the losses in weight are so slight as to be practically negligible. That the change of weight was slight may be accounted for by the inhibiting or retarding effect of the preservative upon the nitrogen and sulphur katabolism. It cannot be maintained,

however, that a retarded katabolism is beneficial to health. On the contrary, a more rapid renewal of the tissues within the limits of heathy activity would be more likely to preserve a normal condition. The old tissues cannot be expected to functionate as perfectly as those which are newer, and hence, within reasonable limits, a change of the tissues of the body must be considered as necessary to a healthy condition and the maintenance of a normal vitality. The final conclusion, therefore, is that the addition of formaldehyde to foods tends to derange metabolism, disturb the normal functions, produce irritation and undue stimulation of the secretory activities, and, therefore, it is never justifiable.

Sulphate of Copper.—The final conclusion, based on the medical and clinical data and on the study of the effect of the copper sulphate upon metabolism, is that the administration of this salt is prejudicial to health.

Potassium Nitrate.—There are some foods which naturally contain small quantities of potassium nitrate. While, however, the data which have been accumulated are not such as to warrant a sweeping condemnation of potassium nitrate in foods, they are sufficiently indicative to justify the conclusion that its presence in foods is undesirable and open to suspicion.

General Considerations.

There can be no justification of the process of adding chemical preservatives to human foods. Success-

ful manufacturing establishments have demonstrated that better, more wholesome, and more permanent forms of food products can be produced without the aid of any preservative whatever. Sterilisation will preserve sweet cider better than benzoate of soda. Proper care in the manufacture of preserves will make a more palatable product, and one that keeps better than the use of salicylic acid. Careful curing of meats and proper care in transportation will preserve these meats better than boric acid. There is no single food product which is not more palatable and of equal if not better keeping qualities when made carefully without the use of preservatives. It is urged by those who employ these bodies that even though considerable quantities of them are injurious to health, which no one denies, yet in the minute quantities in which they are used in foods they cannot be regarded as in any way deleterious. It is easy to show that such an opinion is without scientific basis. It is quite impossible for any expert who holds this opinion to indicate any point in the addition of the preservative to food at which it remains harmless, or the point at which it begins to be harmful. Unless such a point could be fixed and demonstrated upon reliable experimental data, it is evident that no scientific reason can be urged for the use of limited quantities of a preservative, which is acknowledged to be harmful, on the ground that in such quantities it is not injurious. Inasmuch as a preservative is not a food, and as it is necessarily

eliminated by the excretory organs of the body, thus imposing upon them an unnecessary and injurious burden, it is evident that the argument which would permit their use in small quantities is wholly illegitimate.

The fallacy of the argument that small quantities of an injurious substance are not injurious may perhaps be best represented graphically. The chart which accompanies the paper shows theoretically the normal and lethal dose of a food and a drug or, as in this case, a chemical preservative. Taking food, the normal dose of food is represented on a vertical scale as 100: the injury done by an insufficient quantity is indicated by a curve extending downwards and toward the horizontal direction as the quantity is diminished, reaching the zero line when no food at all is given. The actual curve is, or closely approaches to, a segment of a circle. The diminution of food from 100 to 80 shows on the curve very little injurious effect. From 20 to zero of food the curve is approaching the horizontal, and indicates a very much greater proportionate injury. There is a precisely similar diagram representing the action of a preservative; 100 at the top represents the lethal or fatal doze. The normal doze is 0, and is shown at the bottom or zero end of the curve. A very minute quantity of the preservative causes but a slight ascent from the horizontal base, indicating that comparatively little injury is being effected. But as the quantity increases the injurious effect increases still more rapidly, and

the curve approximates more closely to the vertical, until at length the 100 point is reached. It is easy to show by mathematical data that no matter how small the quantity of an injurious substance or preservative is, it will still produce an injurious effect, which may be infinitely small if the dose be infinitely small. It follows then as a mathematical demonstration, that any quantity of an injurious substance added to a food product must of necessity be injurious, provided it is in the nature of a drug and the body is in a perfectly healthy normal condition.

Hence the argument which has been so persistently urged in favour of a chemical preservative that, if in small quantities, it is harmless is shown to be wholly untenable. Where there is no necessity for the addition of a harmful substance, where no particular benefit is secured thereby, and where there is no disturbance of the normal state of health there can be no possible excuse of a valid nature to offer for the exhibition of even minute quantities. That these minute quantities would not be dangerous, in so far as producing any fatal effect effect is concerned, is conceded, but that, in the end, they do not produce any injury, even in these small quantities, is certainly to be denied.

The course of safety, therefore, in all these cases is to guard the opening of the door. If the use of small quantities is permitted, then there can never be any agreement among experts or others respecting the magnitude of the "small quantity," and continued litigation and disagreement must follow. On the other

hand, when the harmfulness of any substance which it is proposed to add to food is established and no reason for its use can be given other than the convenience, carelessness, or indifference of the manufacturer, the exclusion of such bodies entirely from food products follows as a logical sequence and a hygienic necessity.

Criticisms of Wiley's Researches and Conclusions.—Wiley's experiments and the conclusions he draws have by no means been generally accepted. They have recently been exhaustively criticised by Liebreich, who examined the building in which the dietetic researches were conducted, and also had access to the whole of the documents relating to the investigation. Liebreich came to the conclusion that "no injurious effect was produced by the administration of the boron preservatives," and further, that "the administration of the preservative—that is, of borax and boric acid in capsules—allows of no conclusions as to the effect of borates when added to food."

In the course of some comments on Wiley's method of experimenting on preservatives by administering them in capsules, the following remarks are made by *Thresh* in *The Lancet* of *20th. February, 1909*:—

"Two drachms of common salt administered in a capsule would undoubtedly produce discomfort and in many instances actual vomiting. The same quantity distributed throughout the food taken during the day would have no such effect. The person adopting the former method would conclude that common salt was

distinctly injurious to health, whilst anyone adopting the latter method would arrive at the opposite conclusion. As to which would be right the common sense of your readers can decide."

Liebreich principally devotes himself to a criticism of the boron compounds results. It need scarcely be said that chemists and medical men quite recognise that the alleged harmlessness of certain preservatives does not necessarily absolve others from the charge of being injurious and objectionable.

Reviewing the foregoing abstract, it will be noticed that the whole of the substances examined are unreservedly condemned, though not always for quite the same reasons. Thus in dealing with salicylic acid, the objection is taken that "the tissues are broken down more rapidly than they are built up, and thus the normal metabolic processes are interfered with in a harmful way." This hastening of the removal of old tissues is here condemned; but when reviewing the effect of formaldehyde, Dr. Wiley's apprehensions had apparently been allayed. This latter preservative retards the breaking down of the tissues, though only very slightly. On this, Dr. Wiley remarks: "It cannot be maintained, however, that a retarded katabolism is beneficial to health. On the contrary, a more rapid renewal of the tissues within the limits of healthy activity would be more likely to preserve a normal condition."

Touching on some of the illustrations given in the "general considerations," it is said "sterilisation will

preserve sweet cider better than benzoate of soda." This statement, however, cannot be employed in this country as a generalisation. The subjection to a sufficiently high temperature to produce sterilisation impairs the flavour of certain beverages, and for that reason is regarded as an objectionable form of treatment by manufacturers. In the case of lemonade and other liquors put up in gallon jars and drawn off from time to time through a tap, the effect of sterilisation is gone as soon as the first glass is drawn off and air comes in contact with the liquid. Again, the reader is told that "careful curing of meats and proper care in transportation will preserve these better than boric acid." What is understood by the "curing of meats?" Does it include their treatment with salt, and the smoking of hams? If so, where is the difference between treatment with one preservative and another? The paper under examination does not attempt to compare salt and boric acid as preservatives of meats, nor alcohol and salicylic acid as preservatives of beverages. To give one instance, the experience of Limerick manufacturers with butter (page 99) does not agree with Wiley's view that "there is no single food product which is not more palatable and of equal if not better keeping qualities when made carefully without the use of preservatives." Most people again, prefer the flavour of modern mild boric acid cured breakfast bacon to the intensely salt and pickled product of some years ago.

Dr. Wiley proceeds to prove "the fallacy of the argument that small quantities of an injurious substance are not injurious," by methods that in themselves seem utterly fallacious. In the first place, the view of his opponents would not be expressed as Dr. Wiley states it. They would prefer to say "certain substances are injurious in excessive quantities, and harmless or even beneficial in moderate and proper quantities." Take food in general, and any article of food whatever in particular, it is a truism to say that it is injurious if taken in excess. The evils of over-eating are very real evils, and are patent to every one; gout and a number of other diseases follow in its train. Food in excess is indisputably an injurious substance; then applying Dr. Wiley's argument, it is a fallacy to say that smaller quantities of food are not injurious. An ordinary individual requires each day for the maintenance of his bodily equilibrium, a certain weight of nitrogenous foods, and a certain weight of fatty or starchy foods. The weights vary according to the amount of work he does, the surrounding temperature, and other conditions. These kinds of food are obtained in practice from a mixed diet, and naturally one or other is usually taken in excess. But for such inevitable irregularities nature has made provision; within reasonable limits the excess of either is carried off with other ejecta of the body. Not only are the constituents of food in varying proportions, but practically all food stuffs contain more or less matter

which is innutritious and not food at all; as for example, fibrous and other insoluble substances in vegetable products. The natural machinery of the body carries off and disposes of this waste matter also; it can scarcely be contended that in normal quantities these do the eater the slightest harm, and yet, if one were compelled to eat such matter in excess, the effect would be most injurious. The human body is provided with adequate machinery for the purpose of discarding substances which have filled their purposes, or which it does not require. So long as the substances taken into the body do not exceed the limit of what it can naturally, and without over-strain, eliminate; it is submitted that no proof has been afforded that such substances are necessarily doing an injury because in large quantities they are injurious. The degree of concentration may altogether change the effect of a substance on the human economy. Concentrated hydrochloric acid is a most corrosive body, and the swallowing of even a moderate quantity might cause death by destroying the mucous membrane of the stomach. Concentrated hydrochloric acid is therefore a most injurious substance, yet a dilute solution of it is a necessary constituent of the fluids of the stomach, or gastric juice. Being necessary, it is certainly in the small quantity not injurious. It is utterly impossible to accept Dr. Wiley's statement that "it is easy to show by mathematical data that, no matter how small the quantity of an injurious substance or

preservative is, it will still produce an injurious effect." To argue in this manner is just as logical as to say—To attempt to walk a hundred yards through water six feet deep would drown an ordinary man; therefore, to walk one hundred yards through water three feet deep would half drown him, and to walk two hundred yards through water three feet deep would completely drown him.

If Sir Lauder Brunton's view, that preservatives in moderate quantity are less injurious than the natural products of decomposition whose formation they prevent, be accepted as correct, then a certain duty falls on chemists and physiologists. That duty is to ascertain which preservatives are most suitable for use, indicating especially those which are particularly injurious. Having selected those which may be regarded as permissible, the minimum quantities that are efficient for the purpose should be ascertained, and rules laid down for the guidance of those who manufacture and vend articles of food.

Departmental Committee.—An attempt to solve this problem has already been made in this country by the appointment of a Departmental Committee of the Local Government Board in 1899. The Report of that Committee was presented to the Houses of Parliament in 1901. The duty of the Committee was to inquire into the use of preservatives and colouring matters in food, and to report "whether the use of such materials, or any of them, for the preservation

and colouring of food, in certain quantities, is injurious to health, and, if so, in what proportions does their use become injurious." The Committee prefaced their conclusions by some introductory remarks, of which the following is an extract:—

> "It should be borne in mind that under the conditions in which the population of Great Britain lives, and more particularly that portion of it inhabiting the large towns, some preserving agent, not necessarily chemical, appears to be needed in the case of no inconsiderable portion of its perishable food supply. It is common knowledge that the food-producing capabilities of this country do not suffice in all particulars for the needs of its population. Under these circumstances the total prohibition of preserving methods would clearly be likely to be attended with serious results to the public health, in that large quantities of food possessing highly nutritive value might in effect either be withheld from the poorer classes or be liable to be consumed by them in a condition of incipient putrefaction."

The conclusions themselves are too voluminous to permit of their being quoted in their entirety, but are well summed up in the Committee's official recommendations, of which the following is a copy:—

" RECOMMENDATIONS.

Based upon the foregoing conclusions, we beg to make the following recommendations:—

(*a*) That the use of formaldehyde or formalin, or preparations thereof, in foods or drinks be absolutely prohibited, and that salicylic acid be not used in a greater proportion than 1 grain per pint in liquid food and 1 grain per pound in solid food. Its presence in all cases to be declared.

(*b*) That the use of any preservative or colouring matter whatever in milk offered for sale in the United Kingdom be constituted an offence under the Sale of Food and Drugs Acts.

(*c*) That the only preservative which it shall be lawful to use in cream be boric acid and borax, or mixtures of boric acid and borax, and in amount not exceeding 0·25 per cent. expressed as boric acid. The amount of such preservative to be notified by a label upon the vessel.

(*d*) That the only preservative permitted to be used in butter and margarine be boric acid or mixtures of boric acid and borax, to be used in proportions not exceeding 0·5 per cent. expressed as boric acid.

(*e*) That in the case of all dietetic preparations intended for the use of invalids or infants, chemical preservatives of all kinds be prohibited.

(*f*) That the use of copper salts in the so-called greening of preserved foods be prohibited.

(*g*) That means be provided either by the establishment of a separate Court of Reference or by

acid in food has been used by hundreds and thousands of persons day by day, and no one has ever reported an authenticated case of any sign of danger from it." *Case dismissed.*

Preparation of Chemical Evidence.—As an illustration of the chemical evidence that should be obtained when possible in Adulteration actions, there follows a statement of such evidence in cases where the alleged offence is the improper use of a preservative:—

For the Prosecution, it should be proved:—

I. The addition is injurious to health.

(1) Food as prepared has injured health. Instances in way of use, or results of direct experiments.

(2) Preservative is injurious in certain doses. Relation of these doses to quantities in food as ordinarily consumed.

(3) Food is used by special classes of persons, particularly susceptible to action of such preservative.

(4) Preservative is uncertain in composition, *e.g.*, formalin, so excessive quantity can easily be given; or the preservative may at times contain *injurious impurities, e.g.*, early salicylic acid.

(5) Preservative is foreign to human body, or is outside the range of food products.

II. The addition is not required.

(1) The article is made and sold commercially without the preservative.

(2) The article can be preserved without the preservative, as evidenced by laboratory experiments and manufacturing experiments on the large scale.

(3) An excessive quantity of the preservative is used.

(4) The preservative may be used—is used in particular case—to mask uncleanliness, as presence of dirt in the milk.

For the Defence, it should be proved :—

1. The addition is not injurious to health.

(1) Food as prepared does not injure health. Cases of alleged injury. Injury is exaggerated or non-existent—is due to other and unconnected causes, *e.g.*, in lemonade, the citric acid will cause injury long before the salicylic acid added as a preservative—is due to such abnormal idiosyncracy of the individual as to be outside reasonable care and precautions. Dietetic experiments should be made to show such food does not injure health. Use excessive quantities, if possible, on individuals of the same class. If obtainable, produce instances of persons who have used the same food without injury.

Note.—The propriety of any experiments must obviously depend on the *amount of risk*, *e.g.*, one would not repeat experiments with *arsenical beer*. On the other hand, one might give a child ¼ lb. of *aniseed balls* coloured by oxide of iron.

(2) Contra evidence as to injurious nature of the preservative. Dietetic experiments if possible. Show

that the prosecution experiments were made under misleading conditions, *e.g.*, the preservative was administered alone in single doses instead of being incorporated with the food. *Alumed baking powder* case—witnesses for *prosecution* ate alumina prepared from the powder, mixed with water and took it with a meal. *Defence.* Bread was made with the baking powder and then eaten. In both cases contents of stomach removed and examined. The first was not a fair method of making the test.

(3) Shew, if possible, that the special class or classes of persons do not largely use the food. Disprove their particular susceptibility.

(4) Purity of the preservative; show its constancy of composition.

(5) Certain recognised preservatives as saltpetre, smoke, cane-sugar are also foreign to the human body. Salt although a constituent of the body is not necessarily present in the large amount requisite for use as a preservative. Such necessary excess of salt is more injurious than the small quantity of the preservative used. The preservative is a normal constituent of ordinary foods, as salicylic acid, which is found in fruits.

(6) The preservative added is an improved substitute for an old, approved, and recognised one, *e.g.*, boric acid in butter for salt. Prove substitution is an improvement — advantages, flavour, less weight of preservative, etc. Absence of evidence that substitute is any more dangerous or injurious than older and

approved preservative. On the contrary, if possible, evidence that the *new* preservative is less injurious, *e.g.*, interferes less with digestion, etc.

Non-alcoholic beverages.—Prove that they are expressly made for those who regard alcohol as a virulent poison. The substitution, say of salicylic acid for alcohol, is that of a far less noxious article in the view of abstainers—it does not intoxicate with all the alleged train of social evils. Apart from extreme opinion the preservative is productive of far less injury than the equivalent of alcohol.

II. The addition *is* required.

(1) If the article is made and sold commercially without, it is at a high price, prohibitive to the poorer classes. Even when so made and sold the article frequently goes wrong.

(2) Laboratory experiments are no criterion of manufacturing exigences. Conditions of absolute sterilisation are impracticable in manufacture. Prove by evidence of manufacturers of the highest standing. Sterilised foods may undergo unsuspected injurious changes which are better prevented by the use of preservatives.

(3) Quantity used is governed by experience in the particular trade—even with these quantities no injury is done.

The substance is a concentrated syrup, not to be drunk until diluted ; the proportion is then normal.

(4) The manufacturing or other operations are conducted with scrupulous cleanliness—details of precautions observed.

A fair argument for the defence is that in many cases, though criminal in form, these prosecutions are the sole means of deciding matters of great scientific and commercial importance. No idea of fraud or other criminal motive enters. In preservative cases the preservative is only used because of urgent necessities of the manufacture—unless so compelled it would never have been used. The general position and opinion of a trade should have full consideration and not be allowed to be outweighed by the theoretical opinions of witnesses for the prosecution, however eminent.

CHAPTER VI.

More Important Criminal Matters.

Principal Offences Included.—Taken in the order of their seriousness, the following are the principal offences in which chemical considerations and evidence are frequently factors :—drugging, procuring abortion by drugs, poisoning, and attempting to commit these crimes.

Drugging.—Law of, *Offences against the Person Act, 1861, S. 22.*—

> "Whosoever shall unlawfully apply or administer to or cause to be taken by, or attempt to apply or administer to, or attempt to cause to be administered to or taken by, any person, any chloroform, laudanum, or other stupefying or overpowering drug, matter, or thing, with intent in any of such cases thereby to enable himself or any other person to commit, or with intent in any of such cases thereby to assist any other person in committing any indictable offence, shall be guilty of felony, and being convicted thereof shall be liable . . . to be kept in penal servitude for life."

Included in this offence is drugging with intent to rob or kidnap, and generally, the administration of stupefying drugs in order to facilitate the commission of some other crime.

Chemical Evidence for the *Prosecution.*—The identity of the drug must, if possible, be proved, and if it consists of chloroform or laudanum should be named in the indictment. If some other body has been employed, the evidence must show that it was of a stupefying and overpowering nature and calculated to produce the effect alleged. *Defence.*—Show, if possible, that the drug used could not, as employed, stupefy or overpower.

Criminal Law Amendment Act, 1885, S. 3.—

"Any person who . . . applies, administers to, or causes to be taken by any woman or girl any drug, matter, or thing, with intent to stupefy or overpower so as thereby to enable any person to have unlawful carnal connection with such woman or girl, shall be guilty of a misdemeanour, and being convicted thereof shall be liable . . . to be imprisoned for any term not exceeding two years."

Chemical Evidence.—Prosecution.—Prove the stupefying or aphrodisiac character of the drug or thing. *Defence.*—Prove the innocent nature of that administered and consequence absence of intent.

Note.—Where directions are given to prove certain facts, as here the innocent nature of the drug or thing, it is, of course, understood that what is meant

is—ascertain whether such facts exist, and if so, be prepared with the necessary evidence to prove them.

Abortion or Miscarriage.—Law of, *Offences against the Person Act, 1861, S. 58.*—

> "Every woman being with child who, with intent to procure her own miscarriage, shall unlawfully administer to herself any poison or other noxious thing, . . . and whosoever with intent to procure the miscarriage of any woman, whether she be or be not with child, shall unlawfully administer to her or cause to be taken by her any poison or other noxious thing, . . . shall be guilty of felony, and being convicted thereof shall be liable . . . to be kept in penal servitude for life."
>
> S. 59. "Whosoever shall unlawfully supply or procure any poison or other noxious thing, ... knowing that the same is intended to be unlawfully used or employed with intent to procure the miscarriage of any woman, whether she be or be not with child, shall be guilty of a misdemeanour, and being convicted thereof shall be liable . . . . to be kept in penal servitude."

Definition of Poison. Taylor on *Medical Jurisprudence, p. 324, Vol. II.* "A poison is a substance which when taken into the mouth or stomach or when absorbed into the blood is capable of seriously affecting health or of destroying life by its action on the tissues with which it immediately, or after absorption, comes in contact."

Definition of "other noxious thing." The term is employed usually, if not always, with reference to abortifacients. A "noxious thing" may be defined as "a substance which, while not of the nature of a poison as above described, is nevertheless capable of producing abortion."

Chemical Evidence.—Prosecution. In administering, prove that the substance administered was either "a poison" or a "noxious thing."

R. v. Isaacs. L. & C. 220; 9, Cox, 228. The thing supplied with intent to procure the miscarriage of a woman with child must be noxious in its nature. Therefore when the thing supplied and taken was of a harmless character, but owing to the imagination of the woman being powerfully acted upon a miscarriage ensued, it was held a conviction could not be sustained. In this case the prisoner had supplied three bottles of a dark coloured mixture, of which a small portion only was taken. The mixture was analysed and found to contain a considerable quantity of starch and some woody fibre. The analyst arrived at the conclusion that the liquid was some vegetable decoction of a harmless character, and such as would not procure a miscarriage. On these facts the court decided that the thing was not noxious in its nature, and quashed the conviction.

The substance being a recognised "poison," prove the quantity administered, however small.

R. v. Cramp. 14, Cox, 401. The prisoner gave a female an ounce bottle full of oil of juniper, with

intent to procure her miscarriage, and told her to take it in two doses, half at a time. She took half of it at one dose, and it caused her violent sickness. The bottle contained from 500 to 600 drops of oil of juniper. Oil of juniper is used as a diuretic in small quantities, from five to twenty drops; but when as much as half an ounce is taken it acts as an irritant, and produces violent purging and vomiting, which would have a tendency to procure miscarriage. It was *Held*, that the causing to be taken, as much as was taken in this case, was the causing of a noxious thing to be taken within the meaning of the statute. A thing may be a noxious thing within the statute, if when taken in large quantity it proves injurious, although when taken in a small quantity it is beneficial. There follow extracts from the judgments of various members of the court.

Coleridge, L.C.J.—"It is therefore in each case a question of the quantity and the circumstances under which the drug is administered. It is in each case a question for the jury whether the thing, administered as it was under the circumstances, is a 'noxious thing.' Here the thing, as administered, was proved to be noxious."

Field, J.—"The section speaks, first, of poisons; secondly, of other noxious things. If the thing administered is a known recognised poison, I think the offence may be committed, though the quantity given is so small as to be incapable of doing harm."

Stephen, J.—"As to the administration of 'poison,' certain things are known as poisons; and as to these, possibly the administration of a small quantity, with the criminal intent, would be within the statute."

It will be seen that Field and Stephen, J. J., draw a distinction between a recognised poison and a thing which is noxious only in large quantities.

For this reason it is important to prove that the substance is in fact a poison, and recognised as such. The administration of even a small quantity is probably then sufficient to constitute the offence.

The substance not being a poison, prove that the quantity administered is a noxious thing. The foregoing case, *R. v. Cramp*, is an illustration of a thing which was noxious in the quantity administered, though much smaller doses are beneficial. The following cases, *R. v. Perry*, and *R. v. Hennah*, are examples of instances in which the quantity given was in fact not sufficiently large to be noxious.

R. v. Perry. 2, Cox, 223.—The prisoner gave a female two powders and a bottle containing a decoction of feverfew, with directions to take the same for the purpose of procuring a miscarriage. She took one powder only, but no miscarriage resulted. Dr. Davis, for the prosecution, stated as his opinion from the examination of the powder that it was a mixture of savin and fenugreek, the latter being the larger ingredient. The fenugreek would scarcely produce any effect at all; savin, in that quantity, might produce a little disturbance in the stomach for the time, but

would do no further injury. The decoction of feverfew had nothing noxious in it, and a mixture of the powder and the decoction would not alter the properties of either. It was *Held* that the small quantity of savin thus administered is not a "noxious thing" within the meaning of the statute.

R. v. Hennah, 13, Cox, 547. The prisoner, William Hennah, was charged with administering a "certain destructive or noxious thing" called cantharides, with intent to injure, aggrieve, or annoy. The prisoner offered a fig to a young woman, and on her acceptance gave her two. She commenced to chew a portion. It was noticed by her father to contain something glistening, on learning which she spat out what she had been chewing. The other fig was taken to a chemist, and was found to contain from a grain to a grain and a half of cantharides, a quantity insufficient to produce any effect upon the human system. COCKBURN, C.J., in the course of his judgment, said:—"What is important to the present case is that the quantity administered was incapable of producing any effect . . . . unless the thing is a noxious thing in the quantity administered it seems exceedingly difficult to say logically there has been a noxious thing administered. The thing is not noxious in the form in which it has been taken; it is not noxious in the degree or quantity in which it has been given and taken. We think, therefore, the indictment will not hold. It would be very different if the thing administered, as regards either its character or degree, were capable of doing mischief. But because it

happens to fail in a particular instance, from any collateral or unforeseen cause, owing, may be, to the vigour of the constitution of the person to whom it is administered, or some cause of that description, if it was capable of doing mischief at all it would be within the statute."

The reader's attention is directed to the distinction drawn between the administration of a thing in itself innoxious in the quantity given, and one which happens in a particular case to do no harm, even though noxious in itself because of some unforeseen cause, such as unusual strength or drug-resisting power of the person to whom administered.

Defence.—Prove that the substance was neither a poison nor a noxious thing. If a noxious thing, that the quantity administered was so small as to be incapable of doing harm and therefore innoxious.

In procuring.—If alleged to be a noxious thing, for the *Prosecution*, prove that it must be noxious in the quantity supplied. *Defence.*—Prove that the quantity supplied was innoxious.

Administering Poison with intent to Murder.—*Offences against the Person Act, 1861, S. 11.*—

> "Whosoever shall administer to or cause to be administered or to be taken by any person any poison or other destructive thing . . . with intent . . . to commit murder, shall be guilty of felony, and being convicted thereof shall be liable. . . . to be kept in penal servitude for life."

Attempting to administer, *S. 14.*—"Whosoever shall attempt to administer to or shall attempt to cause to be administered to or to be taken by any person any poison or other destructive thing . . . shall, whether any bodily injury be effected or not, be guilty of felony; and being convicted thereof shall be liable . . . to be kept in penal servitude for life."

Chemical Evidence.—For *Prosecution*, prove the substance to be a poison or destructive thing in the quantity administered or attempted. *Defence.*—Prove contra.

Note.—Cocculus indicus berries grow in a pod. The kernel is a poison, but the pod will not dissolve in the stomach, and therefore the whole pod is harmless. It has nevertheless been *Held* that giving the whole pod is an administering within the section—*R. v. Cluderay.* 4, Cox 84. It is immaterial, therefore, whether bodily injury be or be not effected.

Homicide—Murder and Manslaughter.—*Offences against the Person Act, 1861, S. 1.*—

"Whosoever shall be convicted of *murder* shall suffer death as a felon."

S. 5.—"Whosoever shall be convicted of *manslaughter* shall be liable, at the discretion of the court, to be kept in penal servitude for life . . . or to pay such fine as the court shall award, in addition

to or without any such other discretionary punishment as aforesaid."

Definitions—Murder.—The following is that given by LORD COKE (*3 Inst. 47*):—"Where a person of sound memory and discretion unlawfully killeth—any reasonable creature in being—and under the King's peace—with malice aforethought, either express or implied."

Manslaughter is "the unlawful and felonious killing of another without any malice either express or implied." *R. v. Tayler*, 2, Lewin, 215. *Killing by Poison.*—COKE again in "3, *Inst. 48* says, 'of all the forms of death by which human nature may be overcome, the most detestable is that of poison; because it can of all others be the least prevented either by manhood or forethought.' And therefore, in all cases where a man wilfully administers poison to another, *1, Hale 455*, or lays poison for him, and either he or another takes it, and is killed by it, the law implies malice, although no particular enmity can be proved."

Death occasioned by administration of Medicine.—"A medical man must, at his peril, use proper skill and caution in administering a poisonous drug." (*R. v. M'Leod.* 12, Cox, 534).

Rule as to Qualified and Unqualified Men. This is laid down by LORD LYNDHURST in *R. v. Webb.* 1 M. & Rob., 405.—"In these cases there is no difference between a licensed physician or surgeon, and a person acting as physician or surgeon without

license. In either case, if a party having a competent degree of skill and knowledge, makes an accidental mistake in his treatment of a patient, through which mistake death ensues, he is not thereby guilty of manslaughter; but if, when proper medical assistance can be had, a person totally ignorant of the science of medicine takes on himself to administer a violent and dangerous remedy to one labouring under disease, and death ensues in consequence of that dangerous remedy having been so administered, then he is guilty of manslaughter."

Gross Negligence and Manslaughter.—On an indictment for manslaughter against a medical man by administering poison by mistake for some other drug, it is not sufficient for the prosecution merely to show that the prisoner, who dispensed his own drugs, supplied a mixture which contained a large quantity of poison; they are bound also to show that this happened through the gross negligence of the prisoner. *R. v. Spencer.* 10, Cox, 525.

Chemical Evidence.—In criminal matters of grave character, all evidence must be overwhelmingly strong. The rule is, if possible, even more stringent when life is at stake. The proof must be complete in every detail. The defence is under a positive duty to test every link of the chain; and if any be found wanting the jury is bound not to convict. Useful details of the preparation of such chemical evidence are given in *Taylor's Medical Jurisprudence, Vol. II., p. 372.*

NATURE OF PRECAUTIONS TO BE TAKEN.

Character of Articles submitted to chemist.—These may include the stomach or other organs of the body; urine or other secretions of the body; vomit; medicine; food; contents of drinking vessels, etc.

Previous history of these.—As a rule all these articles are first collected by some person other than the chemist, such as a policeman. A non-professional man should, if possible, touch nothing, and see that nothing is touched. To this there is the exception of something that will be lost if not at once recovered. For example, a woman was found dead, with vomit near the mouth running away and soaking into the floor. This should be collected at once with a clean spoon in a clean vessel.

An Expert Medical Man will, on arrival, take note of everything, preserve all necessary articles, put in proper vessels, seal, and arrange for personal delivery to the chemist. On *post mortem* examination the operator will take precautions for the proper packing of essential organs of the body and other substances therefrom requiring to be analysed.

Exact particulars of delivery and receipt of Articles.—The chemist should ascertain as much as possible of the previous history of the case, such as the symptoms preceding death. He should also acquaint himself with the circumstances under which any articles were found, *e.g.*, articles of food, suspected poison, etc., whether in clean vessels or the reverse. Also vomit, whether in clean vessel or possibly collected from a dirty floor.

The nature and efficiency of packages, how fastened, and what identifying marks or seals must also be noted. A record of when and where received and from whom must also be made and kept.

Condition when received.—Note minutely whether seals or packages are entire or show any sign of having been tampered with; also whether putrefactive or other changes have occurred in the contents.

Custody during analysis.—If possible, all articles should be kept in the direct personal custody of the chemist. They must be securely locked up during his absence; products, etc., must be labelled at each stage of the work. If any article or portion of article is given to any other chemist or expert, it must be handed over personally together with a written description. A note must be made of the time, place, and person. At the close of the investigation any remainders must be sealed up in proper vessels, labelled, and kept in safe custody. Or if directions have been received to hand them to some other person, a note must be made of full particulars of the articles handed over, their nature and state, and time when, and place where, and person to whom so handed.

Preservation.—No antiseptics are admissible. Obviously one must not introduce foreign matters. It is dangerous to heat since some of the substances may be volatile. Cold storage is permissible. If spirituous extracts are to be made, at an early stage one may macerate with the spirit, and thus incidentally preserve from putrefaction.

Full details of modes of analysis and results.—These must include when and where analysed, how analysed, full details of methods of analysis, whether assistants were employed, and if so, the exact nature of work done by them. The chemist must be able to speak if required as to the skill of his assistants, and should keep such personal touch with their work as to be able to adopt their results as his own.

Accuracy of Analysis.—The analyst should be able to speak as to the accuracy of his modes of analysis and their limitations. He should also have tested the accuracy of the calibration of his instruments, pipettes, burettes, flasks, hydrometers, etc.

Substances obtained by analysis must be kept.—The active substance may possibly be isolated, in that case it must be carefully preserved for production if necessary, *e.g.*, samples of arsenic, aconitine, etc.

Form and strength of poison administered.—If possible the analyst should determine the form in which the poison was given, *e.g.*, morphia whether as opium, laudanum, or salt of alkaloid. In the matter of strength he should, if able, decide whether given in concentrated or in diluted condition.

Organs or Secretions of body in which found.—These must be noted, as thereby indications of the nature of the poison and the length of time during which it was being administered, are afforded.

Amount of fatal dose.—The analyst should be able to state the amount of fatal dose and its relation to the sex, age, and state of health of the deceased. He

should ascertain the proportion such dose bears to the quantity found on analysis. He should further be able to state what relation this quantity found bears to the quantity administered.

Possible existence of poison naturally in the body.—The poison may have been given as a medicine; for example arsenic, antimony, and strychnine are all recognised drugs. Or it may have been absorbed during the natural avocations of the person; thus lead poisoning frequently occurs in the case of potters working with lead glaze.

Another alternative is that the poison may have been present in food. Thus prussic acid is formed from bitter almonds, and also may be obtained from other fruit kernels. A well-known anecdote is that of counsel who advanced the theory that a person, in whose body prussic acid was found, had himself introduced it by chewing and swallowing apple-pips. The defence was ineffective except that for long after the barrister was familiarly known as "Apple-pip Kelly."

Poison, the result of decomposition.—As the result of certain obscure chemical changes which may occur within the body after death, there may be poisonous bodies produced from non-poisonous substances in the body. These are known as cadaveric alkaloids, or more usually as "ptomaines." As the naturally poisonous alkaloids may possibly be confused with ptomaines, evidence differentiating the two classes of bodies must be forthcoming.

Introduction of poison by impure analytic reagents.—This

is not an unknown experience, thus arsenic has actually been introduced, by means of the reagents, into the Marsh's and Reinsch's tests by which substances were being examined for its presence.

Introduction by improper wrappers.—The obvious duty of the person forwarding articles for analysis is to see that they are packed in proper receptacles. The chemist can only deal with them as they reach him, but he should be on the alert for the discovery of any improper wrapper. Thus a case is on record of a stomach, suspected to contain arsenic, having been packed in a piece of wall paper. The wall paper itself on examination was found to contain arsenic in abundance.

Chemical Evidence for Defence.—The first duty of a chemist who is acting for the defence is to scrutinise most closely the whole chain of evidence for the prosecution. The preceding directions as to the precautions necessary to ensure its completeness should also furnish suggestions to the defence as to the tests to which it may be subjected in order to find any defects in case of their existence. If, for example, the circumstances of death point to a possibility of ptomaine poisoning having been the cause, this should be pressed in cross-examination of witnesses for the prosecution. Such a possibility should be supported by direct chemical evidence that the analytical results are compatible with death from such a cause. Granted any reasonable case for death being due to other causes, or that death by poison has resulted from

any innocent source, the defence must be prepared with all the constructive evidence necessary to build up an affirmative case. This will include evidence in support of the whole chemical argument (and of course equally of the medical one, though the latter at present only indirectly concerns us).

ILLUSTRATIVE CASES.

In the following poisoning cases an account is given of the more important chemical evidence. The figures in brackets (1) refer to notes at the end of each case:—

R. v. Palmer.

On the 14th. May, 1856, William Palmer was tried at the Central Criminal Court (C.C.C.) for the murder of J. P. Cook, who died on the 21st. November, 1855. Cook was seized with symptoms of antimony (tartar emetic) poisoning—vomiting, etc. These were afterwards followed by tetanic convulsions and death. Palmer, who was a medical man, had been attending Cook, and gave him medicines. Palmer had on several occasions bought strychnine, the disposal of which he could not account for. Palmer had a pecuniary interest in Cook's death. The symptoms of death were those of poisoning by strychnine.

A *post mortem* examination was held, at which Palmer was present. The stomach having been placed in a jar, Palmer tried to upset it; and, after the jar had been covered with bladder and tied down, took it into another room and cut slits in the covering (1), but

without succeeding in tampering with the contents. Palmer further tried to bribe the post-boy to upset the trap in which the jar was being driven away for purposes of subsequent analysis.

The contents of the stomach were analysed by Taylor and Rees. They had examined for strychnine, but found none (2); they found antimony in the liver, left kidney, spleen, and in the blood. The stomach had been turned inside out, and the contents were mixed with the intestines (1).

Herapath, Letheby, and others gave chemical evidence for the defence, and argued that no strychnine having been found was incompatible with its having been administered (3).

Taylor's view was that if the minimum lethal dose had been given, none would be left in the stomach, and if it had got into the blood it would be so diffused and diluted as to be incapable of detection (4), and therefore there was no certainty as to its being found at all. Herapath claimed that he could detect $\frac{1}{10,000}$ grain of strychnine.

The medical and other evidence was so conclusive that the prisoner was found guilty and hanged.

Notes.—(1). The most obvious precautions were neglected in the conduct of the *post mortem*. The stomach, etc., should have been more carefully treated, and the contents preserved if necessary in separate vessels. Palmer, a suspect, should not have had any opportunities of tampering with the substances, much less of taking a jar into another room.

(2). According to Taylor's evidence, though he found no strychnine, yet the same processes detected no strychnine in animals specially poisoned for the purposes of analysis.

(3). Herapath's contention only went to prove *he*, Herapath, could have succeeded where Taylor failed. It must be remembered that all this was more than fifty years ago, and toxicological analysis was then in its comparative infancy.

(4). Stevenson believes that with modern methods of analysis, strychnine can hardly fail to be detected in the body in any case of poisoning by this alkaloid proving fatal within a couple of hours. Strychnine is absorbed into the blood unchanged, which is proved by the fact that a dog may be killed by transfusion of blood of another animal which has been strychnised. Strychnine is very resistant to decomposition. Stevenson extracted $\frac{1}{18}$ grain from 2 lbs. of exhumed viscera, six months after burial, though the woman had survived the administration for six hours.

It is remarked in *Taylor's Medical Jurisprudence, Smith's 1905 Edition*, that with such culpable neglect as in this case, the only course is to seek for the poison in the tissues. Detection in the body is a proof it has been taken . . . non-detection does not prove that it has not destroyed life.

A number of indiscretions were committed by the witnesses in this case. Taylor communicated beforehand with the *Illustrated London Times*, and Herapath had expressed the opinion freely that Taylor had not

gone the right way to find strychnine. The strongly partisan character of the evidence led to the following *aphorism of the judge*:—"With regard to the witnesses on the part of the prisoner . . . . there were gentlemen whose object was to procure an acquittal for the prisoner. It is in my opinion indispensable to the administration of justice that a witness should not be turned into an advocate, nor an advocate into a witness."

R. v. Smethurst.

On the 7th. July, 1859, Smethurst was tried at the C.C.C. for the murder of Isabella Banks, who died on the 3rd. May, 1859. A motive for the alleged murder existed. The symptons of illness preceding death were as follows:—diarrhœa and vomiting, dysentery, heat and burning throughout the whole alimentary canal. These pointed to the administration of some irritant poison. No poison was traced to the prisoner's possession, but he as a doctor would have no difficulty in procuring same.

Chemical evidence for the Prosecution.—A part of a motion was analysed by Dr. Taylor, who found it to contain arsenic. The following report of the evidence is abstracted and condensed from *Vol. 50, C.C.C., Sessions Cases, p. 552.*

Taylor in *examination in chief*, deposed that on the 1st. May, he received a parcel delivered by Buzzard. This contained two bottles, which were sealed, he opened one and took out a portion. (1). Before com-

mencing his analysis, he first tested his apparatus and reagents, copper wire, hydrochloric acid, water, and test-tube; he found then all perfectly clean. (2). He then used the same reagents and apparatus, and tested some of the liquid from the bottle he had opened. The result was a metallic deposit of a greyish steel colour on the copper. This might be arsenic or antimony, or possibly mercury. The bottle was then re-sealed in his presence, and taken away by Buzzard. (3).

He made further experiments with some more of the liquid, and obtained a further deposit of grey matter. This he examined under the microscope, and found it to have the appearance of arsenic. He heated a piece of the copper on which was the deposit, and obtained crystals of arsenic. These he produced. (4). He had not the slightest doubt of their identity. There was no indication of the presence of antimony, mercury, or bismuth. He found that arsenic was contained in the blood.

On the 5th. May, he received a large jar from M'Intyre, sealed up—this contained viscera, stomach unopened, and other organs enumerated.

On the 7th. May, and on other specified dates he received other packages, labelled, and numbered them. (5).

On examination he found no arsenic or antimony in the gullet or stomach. He found antimony in two places in the intestine, and traces of antimony in blood taken from the heart. He was assisted by Dr. Odling. (6).

He examined a number of articles of food and medicine. Bottle No. 5 contained 3.5 grains chlorate of potass—free from anything else—it is not muriate of potass. [KCl]

Bottle No. 21 contained a clear watery liquid of saline taste. Handed 1½ oz. from it to an assistant to boil for Reinsch's Test. The copper was destroyed by being dissolved. He plunged a portion of fresh copper in the solution for a very short time, and found arsenic deposited on it.

Subsequent examination showed no arsenic or antimony in the liquid, but that the arsenic found in the original test had come from the copper used for the experiment. (7.) In the ordinary mode of applying the test, witness added, "We never dissolve the copper."

On *cross-examination* by Parry.—When giving evidence before the magistrate, he believed that this bottle contained arsenic. Subsequent examination showed that the original analysis was mistaken.

On *re-examination* by Bodkin.—If half a grain of copper was administered during life, there would not be any action of acid in the stomach that would account for the arsenic in the evacuation. (8). Slight traces of arsenic were found in the copper pills, but none in those of bismuth.

Odling, on examination, stated that in a case where the copper is not dissolved there is no fallacy in Reinsch's test.

Chemical Evidence for Defence.—B. Ward Richardson

was examined by Giffard. Slow arsenical poisoning is quite impossible without arsenic being found in the tissues. (9). He experimented on a dog, giving it white arsenic and potassium chlorate in excess, the latter being a diuretic—he subsequently found arsenic in the dog's tissues.

Various medical witnesses averred that the symptoms were not those of slow poisoning, but of dysentery.

The jury believed the chemical evidence for the prosecution and found the prisoner guilty.

Notes.—(1) The witness states the time when, and the person from whom he received the articles for analysis, also the mode of packing, and that they were sealed.

(2) All apparatus was tested before use.

(3) States what was done with the bottle when finished with.

(4) Produced in Court the substance isolated.

(5) All packages labelled and numbered.

(6) Gives name of assistant whose qualifications were well known.

(7) Example of the poison being searched for having been introduced in the reagents.

(8) Medicines administered could not have been the source of the poison found on analysis.

(9) Defence attacks the evidence for the prosecution on the ground that absence of arsenic from the tissues is conclusive evidence of absence of slow arsenical poisoning. Different argument and conclusion based on facts as advanced by the prosecution.

STEPHENS, J., comments somewhat fully on this case in his *Criminal Law of England, p. 306.* He remarks that Taylor's credit was attacked because on the copper gauze being dissolved by the potassium chlorate, and arsenic liberated, Taylor assumed that the arsenic came from the liquid being tested. The defence tried to draw the inference that his whole evidence was unreliable. But examining that evidence, altogether 77 experiments were made, in 74 no copper was dissolved and no arsenic was found. In 2 tests no copper was dissolved and arsenic was found. In one test, the copper was dissolved and arsenic from the copper was found, thus showing that the test will reveal arsenic. The 74 experiments show that when there is no solution of copper, the test does not reveal arsenic unless it is free in the liquid, as distinct from being combined with the copper. A second argument was based on Richardson's evidence, that arsenic must be found in the tissues in a case of arsenical poisoning. In the judge's opinion, absence of arsenic at death does not show that no arsenic was given during life, but that none was given for the last two or three days of life. The third argument of the defence was that Taylor found antimony and arsenic present in the medicines, which contained bismuth, and therefore in that way such arsenic as was found could be accounted for. An attack was made on the credit of the witnesses for the defence, on the ground that they had also given evidence for the defence at Palmer's trial. Richardson then deposed that Cook's symptoms

were those of angina pectoris, and Rogers that if death were due to strychnine, that poison ought to have been found in the body.

After the sentence, petitions and other documents were sent to the judge (L. C. Baron Pollock), among them being a communication from Drs. Baly and Jenner on the medical evidence, they regarded the symptoms and *post mortem* appearances as ambiguous, and thought they might be due either to natural causes or poison.

The judge recommended the Home Secretary to refer the matter to the judgment of some independent medical and scientific persons selected by himself.

Herapath meanwhile had written a letter to *The Times* asserting that Taylor had extracted more arsenic from the potassium chlorate and copper than could have been set free by the solution of the copper.

The Home Secretary sent the papers to Sir Benjamin Brodie, the eminent surgeon, who reported on the materials supplied him, that there were six reasons for believing Smethurst guilty, and eight for doubting the same, and concluded—"I own that the impression on my mind is that there is not absolute and complete evidence of Smethurst's guilt."

The Home Secretary thereon granted a free pardon. This was at best an unsatisfactory course of procedure. Such a matter would now be referred to the Court of Criminal Appeal.

R. v. Lamson.

On the 3rd. December, 1881, Lamson, a doctor, visited

his brother-in-law, P. M. John, *ætat* 19, at school. He administered a gelatin capsule containing aconitine. Symptoms of aconitine poisoning followed, resulting in death.

Chemical Evidence.—Stevenson stated that analyses were made jointly with Dupré. "Every step taken was arranged between myself and Dr. Dupré before being adopted. The manual operations were sometimes carried on by me and sometimes by Dr. Dupré, and when he performed the analysis I examined it, so as to be able to speak to the result." (1).

We obtained morphia and aconitine; the *latter* by Stas's process from the viscera, etc. Its existence was proved by its general reactions as an alkaloid. The tongue sensations produced by aconitine are characteristic. By the comparative action on mice as against a standard solution of aconitine, $\frac{1}{2000}$ grain may be recognised.

In cross-examination, he gave details of the analytic processes. The effect on the tongue was not like veratria or delphinia, but was characteristic of aconitine (2).

Cadaveric alkaloids may possibly be produced in the stomach after death, but he has seen none producing the same effect as aconitine. *(C.C.C. Reports, Vol. 95, p. 572.)*

The prisoner was found guilty and sentenced to death.

Notes.—(1) Particulars of the analyses having been jointly made were very carefully stated.

(2) The suggestion for the defence is that the analytic results may have been due to something else than

aconitine. The effect on the tongue as a means of recognition depends on the correct estimation of a sensation as distinct from some purely physical means of identification.

(3) The theory that ptomaines (cadaveric alkaloids) had been developed, and that the effects obtained were really due to such bodies, is negatived by the evidence that ptomaines do not in fact produce the same effects.

R. v. Maybrick.

On the 31st. July, 1889, Florence Maybrick was tried at the Liverpool Assizes for the murder of James Maybrick, her husband, who died on the 11th. May, 1889. The alleged motive was intimacy with a man named Brierley. The symptoms of the fatal illness were agreed to be those of gastritis or some similar disease. According to the theory of the prosecution the gastritis was due to administration of arsenic. According to the defence it was due to irritant food or cold through wetting.

Chemical Evidence for the Prosecution.—Nokes, pharmaceutical chemist, had sold to the prisoner some fly-papers containing arsenic, also at the time of purchase she paid for them, although she had a running account. They were delivered in the ordinary way by the boy.

Hanson, pharmaceutical chemist, had also sold arsenical fly-papers to the prisoner under the same circumstances of paying at the time, although she had a running account. At the same time he sold her a lotion containing benzoin and elder flower water,

being the usual ingredients of a skin lotion. These mixed with the arsenic would make a good combination as a cosmetic. (1).

Humphreys, surgeon, attended the deceased during his last illness, and gave him Fowler's Solution on 5th. or 6th. May. This contains arsenic, the total quantity thus administered was $\frac{3}{1000}$ grain. On the 9th he applied Reinsch's Test to the fæces and urine—results negative; but he admitted inexperience in chemical testing, and hence possibly failed in detecting the presence of arsenic.

Davis, analyst, deposed that a bottle of Valentine's Meat Juice handed to him contained ½ grain of arsenic in solution. The normal preparation contained no arsenic. Some arsenic was present in the glass of the bottle, but less than in that of another bottle, the contents of which were arsenic free. (2).

He found no arsenic in the stomach or spleen, but it was present in the liver and intestines. A number of bottles present in the house contained arsenic, as did also a box labelled "poison for cats." One bottle was filled with a saturated solution of arsenic. A tumbler in a hat-box contained milk in which was a handkerchief. This milk contained arsenic equal to from 20 to 30 grains in the whole tumbler. He found arsenic in a jug in which some lunch for the deceased had been taken to his office. A bottle of glycerin in the lavatory contained arsenic, as did also one of deceased's medicine bottles. Stock bottles of the drugs from which the medicine was dispensed contained

no arsenic (3). The fly-papers contained arsenic. Witness produced tubes containing the characteristic sublimate from Reinsch's Test, made respectively on the kidneys and liver. He calculated the quantity in the entire liver to be $\frac{1}{8}$ grain. The amount found was half the smallest amount that the witness had ever found in a fatal case of arsenic posioning.

Stevenson, analyst, stated that he had examined the contents of the stomach, and found no arsenic. In the intestines he found about $\frac{1}{11}$ grain of arsenic, and some arsenic in the kidney. On examining the liver, 4 oz. yielded 0·027 grain of arsenic, equal to $\frac{1}{3}$ grain (0·33) for the whole liver, which weighed 3 lbs. On making a duplicate test, 8 oz. yielded 0·049 grain equal to 0·29 grain of arsenic for the whole liver. (4).

"The body at the time of death probably contained approximately a fatal dose of arsenic."

He did not macerate the whole liver into one bulk. (5).

For the Defence.—Various witnesses stated that the deceased was in the habit of taking arsenic as a medicine. In particular, Stanton, a pharmaceutical chemist, sold the deceased a "pick-me-up" containing Fowler's Solution, 7 drops to the dose, sometimes as often as five times a day. The last occasion was in November, 1887; the quantity in the day was nearly $\frac{1}{3}$ grain of arsenic. On going away from home he took with him 8 or 16 dose bottles. Arsenic is used as an aphrodisiac. (6).

Tidy, chemist, was of opinion that the symptoms and appearances were not those of arsenical poisoning.

Stevenson assumed the quantity present to be 0·3 grain, but witness did not think that warranted. It it is not fair to infer that all the intestines or liver contained the same proportion of arsenic as a portion. They should have been mashed up, and a uniform sample taken. (7). Witness calculated the total quantity of arsenic found to be 0·082 grain. (8). This does not point to over administration. He cited various medicinal cases. No. 1, arsenic was given three months before death, there was found 0·028 grain of arsenic. In No. 2, arsenic was given five months before death, there was found in the liver 0·174 grain of arsenic. In these cases there was no suggestion of arsenical poisoning.

Paul, examiner in Toxicology, Victoria University, had examined similar pans to that mentioned by Davis, and found arsenic in the glaze, which arsenic was set free by acids. (9).

Prisoner's Statement. She had used a cosmetic containing arsenic from fly-papers. (10). Her husband had been taking a powder, this she mixed in with the meat juice at his request. (11).

The jury found the prisoner guilty. (*Times Report*).

Notes.—(1). Evidence of purchase of arsenic under suspicious circumstances, but one witness admitted that the arsenic would make a good cosmetic. The use as a cosmetic might explain the secrecy of the purchase.

(2). The evidence here given had evidently been prepared in anticipation of a defence that the arsenic in

the meat juice had been derived from the glass of the bottle.

(3). *Interesting as a tracing back of the history of the medicine, in order to prove that it contained no arsenic when originally prepared.*

(4). A duplicate test served the double purpose of confirming the accuracy of the first test, and also that the poison was fairly evenly distributed throughout the whole liver.

(5). Evidently an answer given to a question foreshadowing one of the lines of defence.

(6). Evidence of the deceased being an habitual arsenic taker.

(7). *Goes to proof* that the sample did *not* adequately represent the whole of the organ.

(8). The calculation by which the witness arrived at the figure 0·082 grain is not very clear. If the amounts found in the two portions analysed by Stevenson be added together the sum is 0·076, which is only 0·006 grain short of Tidy's estimated total. That 12 oz. of the liver should contain 0·076 grain, and the remaining 2 lb. 4 oz. only 0·006 grain, is exceedingly improbable.

(9). It will be remembered that Davis found arsenic in the food sent to the deceased's office for his lunch. This is an attempt to prove that such arsenic was derived from the glaze of the containing vessel, from which it could be set free by any acids in the food.

(10). This was an explanation of the reason for purchasing the fly-papers. Compare with Note 1.

(11). This was an explanation of the reason why arsenic was found in the meat juice. It would be strengthened by the evidence that the deceased was an habitual arsenic taker.

CHAPTER VII.

CHEMICAL EVIDENCE IN CIVIL ACTIONS.

Scope.—This is practically co-extensive with the whole field of civil litigation. It is difficult to conceive a type of case in which chemical evidence could not possibly have a place.

Breach of Contract.—Such breach may consist in the supply of goods which are not of the nature of those specified in the contract. An interesting case arising out of such alleged breach is that of *Kynochs, Ltd. v. The King*, "Times," 26th., 27th., 28th. November, and 21st. December, 1908. This was a petition of right by Kynochs, Ltd., to enforce a claim for the price of cordite supplied to the War Office. The War Department had rejected the cordite on the ground that it contained a foreign and unauthorised ingredient, namely, perchloride of mercury, the effect of which was to mask certain tests which were applied by the War Office in order to ascertain the keeping qualities or stability of the cordite. In reply, Kynochs, Ltd., admitted the presence of perchloride of mercury, but alleged that the quantity was so infinitesimal as not

to prevent the cordite supplied being in compliance with the terms of the contract.

On behalf of the Crown, chemical evidence was given to the effect that it was the practice in testing cordite to subject it to a temperature of 108° F., and note the length of time which elapsed before gaseous fumes of oxides of nitrogen were evolved. In order to detect the presence of these, a test paper was used containing potassium iodide and starch. The nitrous fumes on liberation turned the test paper blue. Provided the cordite stood this test for 30 minutes, it was passed as satisfactory. If mercuric chloride is added to cordite, the apparent stability of the substance is materially increased. *Dupré* deposed that he had experimented with one part in 200,000, and that had prolonged the time before nitrous fumes were evolved in the heat test from 20 to 60 minutes. On behalf of the suppliants it was asserted that the quantity of mercuric chloride added by Kynochs would not affect the heat test, there being only an infinitesimal trace of mercuric chloride left in the cordite. The witness admitted on cross-examination that the presence of an unknown quantity of mercuric chloride in the cordite would render the heat test an unreliable test. It was admitted that the mercuric chloride had been deliberately added by the manufacturers, but only for the purposes of a steriliser. It was in fact dissolved in acetone, that being one of the ingredients used in the manufacture of cordite. PICKFORD, J., in the course of his judgment said, " By Clause 2 [of the specification]

the whole of the ingredients and materials were to be of the description, and must comply with the tests laid down in the specifications in the appendices. . . . It was necessary to read the specification of acetone, because the mercuric chloride found its way into the cordite through its presence in the acetone. . . . The specification was:—The liquid is to be genuine acetone and must contain no other ingredients; except small quantity of substances which are normal by-products of the manufacture of acetone. . . . Mr. Helcke became the manager [of Kynochs] and was directed to put in, and did put in, 25 grains per 160 lbs. of cordite, that was one part to 50,000 parts of cordite. . . . It was said that a very large proportion of that would be given off in the working, and that, therefore, the amount left would be infinitesimal. . . . The evidence given on behalf of Kynochs was that this small quantity could not possibly affect the heat test. . . . The War Office was entitled to say, 'This mercuric chloride does affect the heat test, and we are not certain how much does affect the test, and there is no method for ascertaining the exact quantity actually present, and we are not going to be put to the trouble and expense of carrying out experiments to find out. . . .' The War Office were justified in rejecting the deliveries."

There was in this case no dispute as to the actual addition of the mercury chloride, and although the suppliants contended that such addition did not in fact affect the heat test, yet they were constrained to admit

that the presence of an unknown quantity of that substance rendered the heat test uncertain. The War office specification laid down most specifically the exact conditions of purity required in the case of the acetone and also the other ingredients. It is difficult to see how the addition of a foreign ingredient could in any way be sustained.

Libel.—Even in such an unlikely branch of the law as that of libel, important chemical questions may arise. An interesting example is that of *Tucker v. Hayes & Finch*, which was heard by DARLING, J., on the 13th. October, 1908, and following days. By the rubric of the Roman Catholic Church, wax candles for altar purposes must contain a certain percentage of wax. Allegations were made that a certain firm's candles did not contain the required quantity. Proof by analytic methods was put in. One eminent chemist had analysed the candles, and certified that the quantity of wax contained was sufficient to satisfy the rubric. The other side asserted that it was not possible by analysis to make anything like an accurate determination, in fact, that for the purpose analysis was actually useless. The analyst admitted that two years ago he could not have made the analysis, and did not know of any other analyst who could make the same analysis. Other eminent chemists were prepared to act as *compurgators* of the analyst; they had made up a difficult mixture and submitted it to him; they found that he analysed the mixture correctly.

This evidence was objected to on the ground of being inadmissible. The point was reserved in order to see whether the line of procedure of the other side necessitated its being used. The case was finally decided on other points of issue; but it is interesting as raising the question of the *competency of analysis* (*not analyst*). The question comes apparently within *Article 50, p. 62 of Stephen on Evidence, 5th Ed.*—"Facts bearing upon opinions of experts. Facts, not otherwise relevant, have in some cases been permitted to be proved, as supporting or being inconsistent with the opinions of experts." To this there is a footnote—"I have altered the wording of this article so as to make it less absolute than it was in earlier additions. The admission of such evidence is rare and exceptional, and must obviously be kept within narrow limits."

This case may be regarded as an echo of the old battle between exact methods of science and the claims of "rule of thumb," a battle that science has succeeded in winning all along the line.

Injurious Food.—Apart from adulteration, food may be injurious by reason of the development of harmful substances as the result of decomposition. For example, pork has from time to time caused illness. Ptomaines may have formed in the food. Chemical evidence may be advanced in proof of their presence or absence.

Nuisance.—This is much more specifically in the

domain of chemistry. The nuisance may be of a chemical nature, *e.g.*, smoke from chemical works, pollution of water supply with chemical waste, etc. For example, *St. Helens Smelting Company v. Tipping* (11, H.L.C., 642 [1865]). In this case Z had chemical works near A's land, the fumes from which kill or stunt vegetation on A's land and reduce its selling value. *Held*, whether the land is or is not rendered less wholesome for human habitation, Z has wronged A.

From the case, the MASTER OF THE ROLLS laid down this principle—where the plaintiff was seeking to interfere with a great work carried on in the normal and usual manner, the plaintiff must show "*visible*" damage.

Salvin v. North Brancepeth Coal Co. (1874), L.R., 9, Ch. 705. JAMES, L. J., commenting on the previous case, said, "As I understand the proposition, it amounts to this, that, although when you once establish the fact of actual substantial damage, it is quite right and legitimate to have recourse to scientific evidence as to the causes of that damage, still, if you are obliged to start with scientific evidence, such as the microscope of the naturalist, or the tests of the chemist, for the purposes of establishing the damage itself, that evidence will not suffice. The damage must be such as can be shown by a plain witness to a plain common juryman."

Quaere.—But if the damage, though substantial, can only be established by chemical tests? For example, the pollution of water supply; the polluting substance

may render water most injurious to health, and yet not be perceptible to the eye, or any other sense of the "plain witness." Chemical evidence must then be admissible.

There are certain types of cases in which chemical evidence is frequently necessary. Among these are—

Passing-off Actions.

The object of these actions is to prevent one man selling his goods as and for those of another. He may not ordinarily do this by using the name of the first vendor's goods, or one so closely resembling it as to be calculated to deceive. The following is an *Exception* to this rule. In the case of the thing sold being a secret preparation, another person who discovers the mode of manufacture may sell the same preparation under the same name. This follows from the decision in the well-known Angostura Bitters Case, *Siegert v. Findlater* (7, C.D. 801, 1878). Siegert made a fluid according to a secret recipe, which became known as "Angostura Bitters." Meinhard, the defendant's maker, made a different bitter, also from a secret recipe, which he also sold under the name of "Angostura Bitters." It was sought to restrain the latter by injunction. In course of judgment, Fry, J., said, "The two [bitters] are perfectly distinguishable, both in colour and taste. I cannot say that Meinhard may not, if he can, make a bitter identical with the Plaintiffs, and if he does so, I cannot prevent him from selling it as "Angostura

Bitters." It is to be observed that the person who produces a new article, and is the sole maker of it, has the greatest difficulty (if it is not an impossibility) in claiming the name of that article, there is nothing to distinguish it from."

What constitutes identity? The judge referred to *secret recipes* for each. No doubt if one person lawfully obtained possession of another's secret recipe, he would be entitled to make and sell the identical article thus made, by the same name. But short of obtaining the recipe, how else could identity be established? If the articles were so similar in colour, taste, odour, and consistency, that a skilled person could detect no difference by the application of any of the senses, the Courts would probably hold them to be identical. Chemical analysis would go to show identity in chemical composition, but there would have also to be identity in physical characteristics. If samples of the two are shown to vary slightly by analysis, in reply it should be shown, also by analysis, that even when made from the same recipe, the ingredients differ from time to time sufficiently in composition to account for the differences in analysis. A useful case for comparison is the "Yorkshire Relish Case."

Powell v. Birmingham Vinegar Brewery Co., 12, R.P.C. 496.—Here, Powell, trading as Goodall, Backhouse & Co., made a sauce which he called Yorkshire Relish, from a secret recipe. Subsequently, the Birmingham Vinegar Brewery Co. also put up a sauce which they termed Yorkshire Relish. Powell

applied for an injunction to restrain the defendants from such use of the words Yorkshire Relish. At the trial of the action the plaintiff called three chemical witnesses, Allen, Hehner, and Stevenson. All deposed that the plaintiff's and defendant's sauces were not made from the same recipes. Further, they each alleged facts on which that conclusion was based, *e.g.*, differences in smell, taste, bulk of sediment and saltiness of taste. Hehner said that different samples of the plaintiff's sauce were undoubtedly made from the same recipe. The defendants called three chemical witnesses, Attfield, Salamon, and Luff. Attfield deposed that with food the sauces were indistinguishable, without food there was a slight difference; they were *practically identical.* The defendant's sauce was somewhat weaker in fullness and body. Salamon said the differences were very slight, "in many other sauces the variations in the same sauce were much greater." The defendants' increased bulk of deposit was due to finer grinding; "the difference between the two sauces was a pinch of salt." Luff said the taste was remarkably alike; with food they were indistinguishable, plaintiff's sauce was hotter and more pungent, but the differences were very slight, the sauces were substantially identical, but not absolutely, as his own figures showed differences.

Stirling, J., in course of judgment said in dealing with the chemical evidence, "There are certain differences in the chemical composition of the two sauces. . . . Mr. Salamon . . . says this, 'I should say the

difference between the two sauces is a pinch of salt'" (that is to say in each bottle) if this were added, all the other analytic data would fall into line, by which I understand him to say that the ingredients, as appearing by analysis, would seem to be very much the same. It is, to be observed, however, that even if the chemical elements ascertained by analysis were identical, it would not necessarily follow that the two sauces were compounded in the same way. . . . Mr. Salamon also said that he did not think any one would distinguish the two sauces in use; they were a wonderful match. Dr. Luff . . . admitted that it would be possible to produce more sauces than one, giving the same results of analysis, and yet made of different materials. . . . On the evidence of these three witnesses alone, . . . I should be of opinion that the true inference was that the composition of the two sauces was not the same, but that they closely resembled one another in taste. . . . By sending their sauce into the market under the name of Yorkshire Relish, the defendants, in my opinion, represent to the public that it is the same article as that hitherto procured under that name. On the evidence to which I have just referred, is this the simple truth? My answer is, No; the assertion goes beyond the simple truth. On the evidence to which I have referred, it might be right to describe the defendants' sauce as a "wonderful match" to Yorkshire Relish, "but not simply as Yorkshire Relish."

The case went to the Court of Appeal and finally to the House of Lords. In the course of the judgment

of the highest tribunal, the law on the difference between similarity and identity is clearly expounded by LORD DAVEY, who quoted with approval the following passage from the previous judgment by KAY, L. J. (13. R. P. C., 275)—

"The defendants made a sauce which, it is said, closely resembles that of the plaintiff in appearance, in chemical ingredients, and in flavour, and it is described by one of the chemical experts who have given evidence as a "wonderful match." But as the defendants do not know the recipe of the plaintiff, nor the manner in which the ingredients are compounded, it is impossible to say that the two sauces are the same. The defendants are, therefore, selling a different sauce by a name which, by itself, would be calculated to induce purchasers to believe that it is the plaintiff's sauce."

The judgment is a strong one, but probably qualified in the mind of the noble lord by the differences before mentioned, *i.e.*, close resemblance, but not identity. But *quaere*, the sauces being *identical* in appearance, chemical ingredients, flavour, and all distinguishing characteristics of the finished sauces, is it impossible to say the sauces are the same? The chemist and gourmet will both say the two sauces are the same. The law, as stated by STIRLING, J., seems to imply the necessity of being compounded in the same way, and KAY, L. J. & LORD DAVEY also attach importance to the manner in which compounded. It is submitted that granted absolute identity in the finished product

a different case arises; the judges in the actual case quoted were guided in their minds by the absence of identity, and felt that that may be accounted for by the method of compounding as well as by differences of composition. It may fairly be claimed that a person setting out to discover the secret of a secret preparation, who has succeeded in making the identical preparation, has discovered the secret and the essential recipe.

To be of value, chemical evidence must establish chemical identity; it should go to show that differences of compounding would not affect the nature or character of the products, and should be accompanied by evidence of identity in all other characteristics. It is submitted, therefore, that had the defendants produced an identical article they would have been entitled to call it by the same name. In preparations such as Angostura Bitters and Yorkshire Relish the line of distinction between identity and a perfect or even excellent match must be a very fine one.

Iron Ox Remedy Co. v. Co-operative Wholesale Society, (24. R. P. C., 425). The plaintiff sold "Iron Ox" Tablets, and sought to restrain the defendants from selling "Iron Oxide" Tablets. The defendants' tablets contained iron oxide which was practically useless as a drug, and also other and useful drugs. The iron oxide was put in with the avowed intention of facilitating competition with Iron Ox Tablets which, however, contained no iron oxide. The defendants contended that iron oxide was in popular demand as a

medicine, and that they were entitled to supply this demand in the way they did. In the course of his judgment, PARKER, J., in reviewing the evidence, said, "The defendants contend . . . that when the public ask for iron-ox tablets . . . they are really asking for nothing more or less than a particular well-known drug. It may be, they say, that the . . . demand for iron oxide has been of recent years largely increased by the advertisements of the iron-ox tablets . . . there is, they say, this undoubted demand for iron oxide, and the iron oxide tablets which we are putting on the market is a legitimate effort to meet a legitimate demand, and that being the case it is impossible to restrain us from using the term "Iron Oxide." Now if the allegations of fact on which that argument of the defendants rests are established, I am rather inclined to think that the contention would be a sound one. . . . After carefully considering the evidence, I think there is no real evidence pointing to the conclusion that when the public ask for iron-ox tablets, they are asking for, or think they are getting the drug iron oxide in tablet form." The judgment is instructive as indicating a case in which chemical evidence of chemical constitution of two preparations was of importance to the plaintiffs. Valuable evidence, in reply, on the part of the defence would have been such as to show what the public required when asking for iron oxide tablets; this was lacking.

General Nature of Patents.

Letters Patent.—Subject to the fulfilment of certain conditions, the Crown is prepared by Letters Patent to protect an inventor for a period of fourteen years in the monopoly of a new manufacture within the realm. The most important of these conditions are that the invention must be new and must be useful. Further, the Letters Patent are granted only in consideration of a full disclosure of the invention by the applicant without any reservation whatever, so that the public may, on the expiration of the term of monopoly, reap the full and complete advantages of the invention. If the inventor omits to fulfil any part of his bargain, the consideration required by the Crown fails and the grant is void.

What may be Patented.—Patents are granted for the working or making of any manner of new manufactures within the realm, provided such manufactures are not contrary to the laws nor mischievous to the State. (This evidently includes chemical manufactures.) That which may be patented, or, in other words, is sufficient subject-matter, is "any manner of new manufacture." The word "manufacture" may be used in two senses, meaning either (1) the operation by which raw material is converted into a finished article, or (2) the finished article itself. The phrase "*working* a new manufacture" applies to the first sense, and include what are generally defined as "process patents"; and "*making* a new manufacture"

refers to the finished article. Therefore, given an article already known as, say, carbonate of soda, any new and improved process of manufacturing the same may be patented. Or if the article is itself previously unknown—as, for example, ionone (the synthetic violet perfume)—then the patent applies to the article itself, and is often termed a "product patent." The exact scope or ambit of these requires to be clearly defined. In the case of a process patent, where the product is old and well known, the patent protects the particular process from being used or colourably imitated. But another patent may be obtained for a different and new process of manufacturing the same product. When the actual product is itself new, the protection is more far-reaching. Thus EYRE, C. J., said:—When the effect produced is some new substance or composition of things the patent ought to be for such new substance or composition without regard to the mechanism or process by which it is produced (*Boulton* v. *Bull*, 1795, Dav. P.C. 208).

The new product, in whatever way produced, is thus protected; the tendency of more recent decisions is, however, somewhat to restrict this, and apparently when it is possible for the new product to be produced by some method totally distinct from that described by the patentee, he is not protected against such other absolutely new and different mode of manufacture. The Courts scrutinise very closely and somewhat suspiciously any such alleged different methods of producing the patented new product.

It will be readily understood that an exact definition of what is patentable is practically impossible, but the necessity of its having to be a manufacture precludes the patenting of what is simply a discovery, that cannot be regarded as a new art. For example, although the invention of a new surgical operation may be a marvel of genius, it is not a new manufacture and cannot be made the subject of a patent.

As a guide in deciding whether or not any particular invention can be patented the following paragraphs *a* to *h*) will be found of great use. Frost, in his standard treatise on Patent Law and Practice, states that all patents which hitherto have been upheld may be classed under one or more of the following heads:—

(*a*) **New or old methods of applying new principles.**—An abstract principle cannot be patented, but provided the principle be new, any method of application, whether new or old, may form the subject-matter of a patent. An example is found in *Neilson* v. *Harford* (1843, 1. W.P.C. 673), in which a patent for the new principle of applying the hot-air blast instead of cold-air blast to the smelting of iron was upheld. On crystallisation having been first discovered a method of its application to the purification of chemicals would be an invention of this class.

(*b*) **New methods of applying old principles.**—As a method of finishing hosiery goods the application

of a heated iron surface was old. The new method of applying the old principle by using a steam-heated flat-iron box was patentable, but this did not prevent a separate patent being obtained for finishing by means of a steam-heating iron roller, that being another method of applying the same principle. Crystallisation being old, its application to the purification of chemicals would be an example.

(*c*) **New contrivances applied to new objects or purposes.**—At the time when compressed tablets of drugs were first introduced, any new contrivance for making the same would fall within this group. Patents for new drugs or other products will usually come within this category.

(*d*) **New contrivances applied to old objects or purposes.**—A new machine for making pills, which are old, would belong to this type of invention.

(*e*) **New combinations of new or old, or partly new and partly old, parts, which result either in the production of a material object or process.**—These are what are called "combination patents." If a new combination is made of two things which are quite old and well known, and such combination is useful and novel whether as a process or product, it may be patented. As an example the combination of two flat wicks parallel to each other in an oil lamp has been held sufficient to warrant the grant of a patent.

visional protection. The complete specification must accurately describe and claim what is regarded as the invention. Obviously the same invention must be described in each specification. The documents are examined, and, if found in order, the patent is granted on the payment of the specified fees.

Samples in case of Chemical Invention.—In Section 2, s.s. 5, it is enacted that :—

> When the invention in respect of which an application is made is a chemical invention, such typical samples and specimens as may be prescribed shall, if in any particular case the Comptroller considers it desirable so to require, be furnished before the acceptance of the complete specification.

In his report for the year 1907, the Comptroller-General of Patents makes the following comment on this section of the new Act :—

> "With the object of checking applications for speculative patents for alleged inventions based only on chemical theories, and not submitted to the test of experiment, Section 2 (5) has provided that where the invention in respect of which an application for a patent is made is a chemical invention, such typical samples and specimens as may be prescribed shall, if in any particular case the Comptroller considers it desirable, be furnished before the acceptance of the complete specification."

This is one of the most important alterations made by the Act of 1907, the object being to pin down the inventor to his exact invention and no more. For example, suppose that before sulphates were known some inventor had discovered how to make sodium sulphate, he might claim as his invention the manufacture of not only sodium sulphate but also of the sulphates of other metals or groups of metals indicated by him. Although his invention was only sodium sulphate, he would have thus "pegged out" as his territory the whole of the other sulphates, although they were an unknown land which he had not as yet even "prospected." Under the present Act, if he wishes to establish his title to the wider territory, he must, when required by the Comptroller, "effectively occupy" it by making and submitting typical specimens of the sulphates he wishes to claim. Much controversy has ranged round this particular enactment; it must be left to experience to show its effect in actual working.

In some form or other, chemical evidence as to identity will no doubt be utilised in dealing with these samples.

POWERS OF COMPTROLLER.

Very wide powers are, by the Act, granted to the Comptroller-General. Among other things he

1. Hears and decides any Opposition to a Patent.

—Any person may oppose the grant of a patent on the following grounds, S. 11 :—

(*a*) "That the applicant obtained the invention from him, or from a person of whom he is the legal representative; or

(*b*) That the invention has been claimed in any complete specification for a British patent which is or will be of prior date to the patent the grant of which is opposed, other than a specification deposited pursuant to an application made more than fifty years before the date of the application for such last-mentioned patent; or

(*c*) That the nature of the invention or the manner in which it is to be performed is not sufficiently or fairly described and ascertained in the complete specification; or

(*d*) That the complete specification describes or claims an invention other than that described in the provisional specification, and that such other invention forms the subject of an application made by the opponent in the interval between the leaving of the provisional specification and the leaving of the complete specification,

but on no other ground."

The grounds of opposition are strictly limited, and clearly set forth. The fifty years' limit obviates the necessity of going further back than that period in the search for any previous specification in which the same invention may have been claimed.

2. **May revoke Patents on certain grounds.**—The Comptroller has power to hear and decide applications for revocation, S. 26:—

"Any person who would have been entitled to oppose the grant of a patent, or is the successor in interest of a person who was so entitled, may, within two years from the date of the patent, in the prescribed manner apply to the comptroller for an order revoking the patent on any one or more of the grounds on which the grant of the patent might have been opposed;

Provided that when an action for infringement or proceedings for the revocation of the patent are pending in any court, an application under this section shall not be made except with the leave of the court."

By this section very considerable extension is made of the functions of the Comptroller, who may hear and decide applications for revocation made on certain grounds. The Courts and the Comptroller, both, have now therefore jurisdiction in matters of revocation. The object of this section of the new Act is to provide a less expensive tribunal for the hearing of the simpler revocation proceedings.

3. **May hear evidence**, S. 77:—

"Subject to rules under this Act in any proceeding under this Act before the comptroller, the evidence shall be given by statutory declaration in the absence of directions to the contrary; but in any

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case in which the comptroller thinks it right to do so, he may take evidence vivâ voce in lieu of or in addition to evidence by declaration, or allow any declarant to be cross-examined on his declaration."

Merits of Patent.—On the general merits of a Patent, the Comptroller's function is to decide whether the same invention has been the subject of any previous British patent during the preceding fifty years; and whether the subject matter is properly described; and whether in a certain event there is disconformity between the provisional and complete specifications.

The Law affords Remedies both to and against the Patentee.—The patentee is entitled to protect himself by an action of infringement against any invasion of his exclusive rights.

On any unauthorised person having taken some substantial portion of a patented invention and applied it in any way to his own use or benefit, the patentee has grounds for an action of infringement. The infringement may consist in using a patented process or making a patented article either for one's own benefit or for disposal to others.

In cases where a patent is bad through lack of the essential elements of validity, or has been obtained in derogation of the lawful rights of others, the persons so prejudiced have a good defence in an action of infringement, and may also present a petition for revocation of the patent to the Court.

A person prejudiced by the existence of a patent which he believes can be demonstrated to be invalid, may, if he wishes, disregard the patent altogether and proceed with the manufacture which is ostensibly patented. If infringement proceedings be instituted against him, a defence in which he succeeds in showing the patent to be bad will be successful. In the same action, he may by counterclaim obtain the revocation of the patent.

There are cases, however, where some other course is desirable; a manufacturer may not wish to run the risks of an action of infringement, but would prefer to know that the coast was clear before attempting to make use of what is the subject-matter of the patent in question. His appropriate remedy in that case is a petition for revocation, which may be presented to the Court. It is not every member of the public who is entitled to present this petition, but only those who have had certain defined rights invaded, or who may on the general merits of their case succeed in obtaining the authority of the Attorney-General for the presentation of their petition. The grounds for revocation having been proved to the satisfaction of the Court, an order for revocation is made. The effect is that the letters patent conveying the grant are recalled, and the patent is no longer in existence.

Action of Infringement.—The plaintiff must deliver as a part of his Pleadings, a document called "Particulars of Breaches." In this he must give an instance or

instances of the infringements on which he relies. In defence, the defendant must deliver "Particulars of Objections." He may allege (1) that he has not infringed the plaintiff's patent; (2) the patent is invalid, because, *inter alia*, the alleged invention is not new, and/or not useful.

Petition for Revocation.—The Petitioner must deliver "Particulars of Objections," which are broadly similar in character to those in the defence to infringement actions. The respondent rebuts these, and essays to prove the validity of his patent.

Chemical Evidence.—In chemical patent actions, the chemical questions arising almost all resolve themselves into that of identity between two or more processes or products, or that an alleged invention is not useful.

In infringement, the plaintiff says "your process is the same as my patented process." The defendant replies "My process is different from your patented process, therefore there is no infringement. Your patented process is identical with an older process, and therefore is not new."

In revocation, the petitioner says, "Your patented process is identical with an older process, therefore the patent is invalid. Further it is not useful." The respondent in reply says, "The two processes are different. My patented process is useful."

In the chemical proof of such matters, new problems

are introduced. There are not only matters of analysis, but also of the nature and history of the development of chemical processes and manufactures.

ILLUSTRATIVE CASES.

The following cases have been selected because of the interesting nature of the chemical problems involved, and because important principles of patent law have been laid down in the various judgments. The figures in brackets (1), refer to notes at the end of each case.

Badische Anilin und Soda Fabrik v. Levinstein (24, Ch. D., 1883, 156; 2, R.P.C., 73; 4, R.P.C., 449).—The plaintiffs were owners of a patent for producing dyes called sulpho-acids of oxyazo-naphthaline. Four processes were described in the specification; the defendant was alleged to have infringed the third process. The defendant denied the validity of the patent and any infringement; he further alleged prior publication. *Held* in *Ch. D.*, PEARSON, J., that the patent was valid; the defendant had infringed as he had employed the same processes and the same materials to produce the same results.

The *Court of Appeal* reversed this decision by a majority of judges, BOWEN, L. J., and FRY, L. J.; BAGGALAY, L. J., dissenting. *Held*, the specification was insufficient, and the defendant's process was an infringement.

The *House of Lords* reversed the judgment of the Court of Appeal, and restored the order of PEARSON, J.

Judgment of PEARSON, J.—The following are extracts from, and a condensation of the judgment:—The plaintiffs complain that the defendant made dyes according to the processes described in the patent. The defendant answers the patent is void, and even if a good patent, he, as a manufacturer, has invented and used a " secret process substantially different from the processes described in the patent, and has therefore not infringed the patent. . . . The real subject of this patent is [the production of] sulpho-acids of oxyazo-naphthaline, and . . . unless the patent practically shews how [these] are to be obtained, the patent is not a good patent." In the first process, "'naphthylamine' is mentioned as an ingredient; to this the objection is taken that there are now two naphthylamines, known respectively as the alpha- and beta- varieties. The general name includes the both, and if it included beta-naphthylamine, the whole patent was bad because either it went too far or did not sufficiently describe." The learned judge then proceeded to decide "that the word naphthylamine in the patent means that which was generally known in the year 1878 as naphthylamine, namely, what is now described as alpha-naphthylamine. . . . Down to the year 1880 beta-naphthylamine was an article only used in the laboratory, . . . which was not commonly known . . . and certainly for all commercial purposes . . . hardly existed. . . . I am satisfied that at the date of the patent, . . . any person ordering naphthylamine simply, would have been supplied with the old

naphthylamine. . . . It would be improper to come to the conclusion that any naphthylamine was meant in this patent except that which was known simply as naphthylamine, that is, that which is now properly described as alpha-naphthylamine." (1) A part of the process of manufacture consisted of treatment with fuming sulphuric acid, containing about 80 per cent. of sulphur trioxide. It was said that this acid was so strong that the greater part of the raw material, oxyazo-naphthaline, would in course of manufacture be charred if not actually burnt. "There was a great deal of conflicting evidence upon this subject." As a result, the learned judge directed Professor, now Sir Henry, Roscoe, to make an independent report to the Court. The *Order of the Court* is given in 2, R.P.C., 77. It directs a copy of the specification to be forwarded, and requests Roscoe to perform certain experiments which consisted of manufacturing the dyes according to the instructions of the specification. It further requests him to test carefully all the materials he employs, and to see that he has no communication with any of the parties to the action; but one chemist representing either party was permitted to be present.

Roscoe then reported the results of his experiments; with regard to the use of fuming sulphuric acid he said, "I now proceeded to try the process . . . with a sulphuric acid containing 80 per cent. of sulphur trioxide. I did not find it either dangerous or impossible to follow implicitly the directions as there

given . . . [details of the experiments here follow] and therefore I conclude from the above experiments that . . . the process involving the use of 80 per cent. acid is superior to the others. I am also of opinion that this process can be carried out without danger, provided that proper appliances are made use of." (2) Commenting on Roscoe's Report, PEARSON, J., continues, "With ordinary care chemists properly instructed could as easily perform this third process as they could perform the first process."

"Levinstein . . . set up by his defence that he had a *secret process.* Of course the question as to whether or not that secret process is a process which is within the terms of the patent is what I shall have to consider. . . . [To state to the public his secret] might do him irreparable mischief. . . . I heard Mr. Levinstein's description of that secret process with closed doors, no persons being present except the parties and their scientific assistants. (3).

On the principles of deciding the question of infringement, the learned judge said, "One is this, that in these chemical cases where a patentee has made some discovery in chemistry, any person may afterwards use for the same purpose chemical equivalents which were not known to be chemical equivalents at the time the patent was taken out. (Example, *Unwin v. Heath*, 2, Web. P.C. 302.) And I fully agree with the doctrine which has been repeatedly laid down . . . . that though the use of a chemical or mechanical substitute which is a known equivalent to

the thing pointed out by the specification, and claimed as the invention, amounts to an infringement of the patent; yet if the equivalent were not known to be so at the time of the patent and specification, the use of it is no infringement" (4).

A second principle, no less important than that, is this, that where a patent is taken out for a process for arriving at a known result (I mean a result known before the patent is taken out for the process *simpliciter*), any other person may take out a patent for another process, or may use another process without taking out a patent, without any infringement of the process just taken out. But when a patent is taken out for a *new result* not known before, and there is one process described in the patent which is effectual for the purpose of arriving at that new result at the time when the patent is taken out, the patentee is entitled to protection against all other processes for the same result" (5). . . . . I really have to consider whether Mr. Levinstein's secret process comes under the first principle—a new discovery of a chemical equivalent, or whether it comes under the second principle — whether it is simply a discovery of a new process, if it be a discovery at all, to produce the same result which is patented by the patent. . . . . Levinstein . . . . does not use fuming sulphuric acid, but . . . . a known chemical equivalent to it . . . . the process he has used is a process which is [superior in almost every way] to the process mentioned in the patent. It is said that that is

entirely a new discovery of Mr. Levinstein's. . . . . I do not entertain a doubt that [it is] a chemical operation . . . . known to be equivalent at, the time the patent was taken out . . . in what he has done he has simply by experiment and pursuing courses well known in chemistry adapted to this particular . . . . process, processes which have been used for other subject-matters, although it had not been found, possiby because it was not wanted, that they were capable of being used with regard to [this process] . . . . The processes employed by Mr. Levinstein are processes deserving of great praise; but they are simply processes which produce exactly the same results from the same materials which are produced by [*sic.* evidently, *used in*] this patent. The same object is pursued, the same materials are employed, the same result is attained. I cannot do otherwise than come to the conclusion that those are merely processes, that they are not a new invention differing from the patent, but are in reality the manufacture of the sulpho acids of oxyazo-naphthylamine by a process differing in some respects from the process employed according to the patent" (6). Issue decided in favour of the plaintiff.

(1). An important principle is here laid down. Chemical names must be taken to signify that which they meant *at the date of the patent,* and not what they meant at some time after.

(2). This was the first case of a referee being appointed in such matters as these by the Court

The process of manufacture was stated to be sufficiently described. Roscoe's report should be read *in extenso* as an example of what such a report should be.

(3). Levinstein's process being of the nature of a secret, an important concession was made by the Court for his protection.

(4). *Doctrine of Chemical Equivalents.*—The meaning of this term is not the same as that in pure chemistry. It means rather a substitute which may be used to replace another substance in a process of manufacture. If the equivalent is well known, its use is an infringement. If it is a new invention, there is no infringement.

(5). Here is shown the distinction between a "master patent," in which is embodied an entirely new invention, as against a mere "process patent," in which the invention is for a new process for the manufacture of a known product.

(6). The judgment indicates very clearly the line of distinction drawn between known equivalents and a sufficiently new departure to be regarded itself as an invention. The particular instance is evidently very closely on the border line.

Chemical Evidence.—Almost every word of the judgment is pregnant with suggestions to the chemist and the advocate. They indicate the mental attitude of the judge toward chemical problems of this kind. In every action the chemical evidence forthcoming must be that which shall answer the questions the

judge is likely to ask himself. The plaintiff's evidence would go to show that the infringing process was a known chemical equivalent, and that the patent was for a new result. The defendant's evidence should prove that his process was not an equivalent, but a newly invented process, and that the patent was a process one, and not for a new result.

Identity of Products is a matter of analysis, and is subject to precautions of the same kind as have been previously explained.

Identity of Processes is a somewhat larger matter. Those under investigation should be compared under the precise conditions set down in the specification. If the experiments are made on the laboratory scale it should be carefully considered whether any effects can arise from the differences in quantities operated on. The witness should be prepared with experiments, or reasons for the opinions advanced. If possible, laboratory experiments should be confirmed by experiments on the actual manufacturing scale.

No Prevision in Chemistry.—A doctrine now widely held, and frequently insisted on is that "there is no prevision in chemistry." Substances may apparently, and theoretically, be equivalents for each other, and yet, when tried the presumed equivalent may produce results altogether different from those which were expected. The application of this principle very considerably

narrows the doctrine of equivalents, and to the same extent widens the scope of what may be new invention

Insufficiency of Description.—One of the points at issue in this action was whether or not the invention was sufficiently described in the specification. The kind of description necessary is laid down in the following proposition by Frost:—"The complete specification must be intelligible to ordinary workmen possessing the ordinary skill and knowledge of that branch of the useful arts to which the invention relates." Commenting on this Frost says "it is apt to lead to great confusion if it be not clearly borne in mind that the 'ordinary workman' is to be regarded as a person of very different knowledge and skill according to the nature of the field of invention with which the patentee in a particular case is dealing . . . . *e.g.*, if the invention relates to the production of a chemical product by a process or series of processes to the understanding of which a knowledge of the most recent developments of chemical theories, and ascertaining facts is indispensible, then the 'ordinary workman' becomes a highly trained chemist, who may be properly called upon to bring his special knowledge of the particular branch to which the invention relates into play, for the purpose of giving minute directions to his less skilful subordinates, so as to enable them to perform the operations necessary to the carrying out of the process, which they by their lack of knowledge may not be able to fully appreciate."

In chemical cases the "ordinary workman" is frequently impersonated in the witness-box by chemists of the very highest eminence. But great minds view their own powers with the most profound humility, and never is this more strikingly manifested than when such eminent chemist is testifying to the insufficiency of description in a specification. Functioning as an "ordinary workman," he is quite unable to understand that which is perfectly simple and plain to equally great intellects; also functioning as "ordinary workmen" on behalf of the other side.

Nobel v. Anderson, 11, R.P.C., 115. The plaintiffs were assignees of a patent for "Improvements in the manufacture of Explosives," one claim was for the manufacture from nitro-glycerin and *soluble* nitro-cellulose, of a horny explosive compound. The defendants made a smokless powder called "cordite," from nitro-glycerin and *insoluble* nitro-cellulose. There was a conflict of chemical testimony as to what were known at the date of the patent as soluble and insoluble kinds. *Held,* the plaintiff's claim was confined to a powder made from *soluble* nitro-cellulose. The defendant's interpretation of soluble was correct, the patent was valid, and the defendant had not infringed."

(A conflict of chemical testimony is no unfamiliar thing in almost every chemical patent case).

The plaintiff's chemical witnesses included—Odling, Roscoe, Tatlock, and others; the defendant's—Dewar,

Abel, Lunge, Dupré, Armstrong, Frankland, Crookes, Bramwell, and others.

ROMER, J., in the course of his judgment, said, "At the date of this patent nitro-cellulose consisted of two well-known and distinct kinds—the soluble and the insoluble. . . . Speaking generally the first was soluble and the second was insoluble in ether-alcohol. . . . . Turning to the plaintiff's specification, his claim at the end is limited to *soluble* nitro-cellulose. Moreover, in one part of his specification he refers to the use of certain facilitating solvents, while all of these are solvents for the soluble kind, some of them are not solvents for the insoluble kind of nitro-cellulose. . . . . The plaintiff has therefore confined his claim to the manufacture from the soluble nitro-cellulose, and in his opinion he has selected the soluble as distinguished from, and in a sense as opposed to, the insoluble. . . . . The patentee might well shrink from trying to use the highly explosive gun cotton [insoluble] instead of the comparatively safe collodion cotton [soluble]. . . . . One chemical problem he solved, and he has obtained all the advantage appertaining thereto which he can legitimately claim. A further and distinct problem he left unsolved, and he ought not to be allowed to take away from the person or persons who ultimately solved it the benefit of their success. . . . . Cordite is made according to a patented invention of Dewar and Abel . . . . they have solved the problem . . . . how to make a good powder out of *insoluble* nitro-cellulose and nitro-glycerin. . . . . The

insoluble cannot be regarded as in any true sense the equivalent of the soluble nitro-cellulose. . . .. . There is no infringement, and the action fails."

The chemical evidence required in this and analogous cases is again suggested by the problems considered by the learned judge. The case differs from the *Badische case*, inasmuch as here it is held that there was no chemical equivalent, but a new process, and not a general or master patent, but one which specifically excluded from the invention patented, that which constituted the alleged infringement.

Monnet v. Beck, 14, R.P.C., 777. This was an action for the infringement of a patent for the manufacture of new dyes. The defendant denied any infringement, and alleged that the patent was invalid, because the specification was insufficient, the invention of no utility, and had been anticipated. It was *Held, inter alia,* the plaintiff claimed the invention of a new metallic salt . . . . that this was an impossible product and not a valid claim, as the plaintiff was either claiming an impossible process, or a process he had not described. The action was dismissed with costs.

The case is interesting from the nature of the chemical evidence called. Passmore gave evidence of the chemical constitution of organic bodies, and exhibited the graphic formulæ of same. These included di-methyl-meta-amido-phenol-phthalein. It was generally submitted on behalf of the patentee that he

had made a mistake in his chemical theories only. Dewar, for the defence, stated that he had experimented, following the specification, and had been unable to make any potassium salt as described. Owing to the "extraordinary conflict of evidence," counsel for the plaintiff asked for a reference to a competent referee. The application was not acceded to.

WILLS, J., in course of judgment, said, quoting the specification, "The object of this invention is the manufacture of new dyes called 'anisolines' from the rhodamines. There is then given a formula for the salts form by a particular rhodamine with monovalent metals. . . . . This metallic salt, which beyond all doubt is the starting point from which the process claimed sets out, is not only non-existent, but impossible. With a profound and implicit trust apparently in symbols which I do not profess to understand, Monnet assumed that the first stage of the process described led him to the starting point of his claim, and gave him a potassium salt. The very simplest experiment would have shown him that it did not exist in fact, and it is now conceded that it is an impossible product. . . . . When Monnet says, "I claim the method of obtaining anisolines by substitututing for the metal of rhodamine salts an alcoholic radical, he was proposing to substitute an alcoholic radical in a non-existing and impossible chemical combination. What he had really got was the rhodamine base of the hydrochlorate of rhodamine with which he set out. It seems to me that, looking

at what it is that he claims in the most unmistakeable language, this cannot be a good claim. Chemical reactions are surely as much a part of a chemical process as the admission of steam into a cylinder . . . . would be part of a mechanical process. If there is one thing more than another which is insisted upon in the patent as of its essence, it is the chemical reaction or group of reactions, which constitute a substitution for an impossible thing.

It is said on the other hand, "This is only a mistake of theory. The patentee describes his process. He arrives at a rhodamine base which he calls a salt, but he only makes that substance the starting point of a fresh process, which works out the desired result. . . . . The argument is taking, but I do not think it is sound. . . . . But it seems to me that Monnet has throughout his specification, and still more in his claims, driven the error so deep down into the process claimed that it is impossible to adopt the "benevolent" style of construction contended for on his behalf. The mere process down to . . . . the formation of the anisoline . . . . save for the supposed formation of the potassium salt . . . . was not new . . . . it was necessary (so far as process was concerned) to find something new before . . . . [the] time the anisolation was complete, under which circumstances one can understand the importance, from Monnet's point of view, of giving a new character to his process by making the most of the use of the metallic salt which he thought he had invented. Accordingly he makes

that metallic salt, it seems to me as to process, the very pivot of his invention. . . . . It seems to me that you may put it in two ways, either of which is fatal to the patent. It may be said, "You are claiming an impossible process," which cannot be the subject of a patent, or if it be urged that Monnet's specification, apart from the claim, does not really describe a process depending upon a metallic salt, then, "You are claiming a process which is not the one you have described, which is equally fatal." The deductions are made clear in the last sentence of the judgment.

Chemical Evidence.—This may be directed to theories of chemical constitution—impossibility of process—and inaccuracy of description.

Parliamentary Committees.

During the consideration of *private bills* by Parliamentary Committees, chemical questions not infrequently arise, *e.g.*, one local authority may be promoting a scheme for the disposal of sewage, another may oppose on the ground that it will cause pollution of their water supply.

Chemical evidence may be given on both sides. The general principles are the same as elsewhere.

Principal point of difference.—These Committees are composed of business men rather than lawyers, and in consequence the rules of evidence may be

somewhat relaxed. Matters may be admitted that more strictly legal procedure would reject. Each side will, therefore, be ready to fully avail itself of any such opportunities thus afforded.

CHAPTER VIII.

PRACTICE.

Inception of Cases.—This will depend on the nature of the case.

Food and Drugs Acts.—The purchase is usually made by an Inspector or some one acting on his behalf. He divides the sample into three parts, and forwards one portion to the public analyst, gives the second to the vendor, and reserves the third portion for further analysis by the Government authorities if necessary. The public analyst's report is submitted to the local sanitary authority, usually the sanitary committee of the local council. If the report is unfavourable, the sanitary authority may decide to prosecute. If so, the materials of the case are handed to the solicitor.

Note.—In many cases the Inspector himself conducts the prosecution. Then the subsequent considerations for solicitor and counsel also apply to him.

More important criminal matters usually come under the cognisance of the police, and through them to the prosecuting solicitor.

Civil matters.—The person aggrieved by what he considers a wrong inflicted on him by some other

person will communicate the facts of same to his solicitor.

The *person against whom* the *attack is made* in any of the above instances will, in matters of any importance, also consult a solicitor.

In one or other of these ways all such matters ultimately reach the solicitor.

Proceedings under Food and Drugs Acts.—In consequence of their special nature, it will be well to deal with these separately. Thus, for example, in such proceedings analysts' certificates are themselves received and admitted as evidence.

Division of Samples.—There have been a number of High Court decisions on this subject. The following are some of the more important:—

Each article purchased must be divided into three parts.—In *Mason v. Cowdary*, 1900, 2, Q.B., 419, an inspector bought six small bottles of camphorated oil, and divided them into three lots of two bottles each. On appeal it was *Held* that "Where a purchase is made of several articles of food or drugs at the same time for the purpose of analyis, each article purchased must be divided into three parts, and otherwise dealt with as required by S. 14 of the Sale of Food and Drugs Act, 1875. Where a purchase is made of six bottles of the same article of food or drug, each bottle is, for the purposes of the Act, a separate article, and it is not therefore a sufficient

compliance with the requirements of S. 14 for the purchaser to divide them into three lots of two bottles each without opening any of the bottles, and to hand one lot to the analyst, one to the seller, and to retain one for himself."

The contents of small packages may be mixed before division.—Thus in *Smith v. Savage*, 1905, 2, K.B., 88, a grocer was asked if he sold cream of tartar, and in reply produced a box containing penny packets labelled "cream of tartar." The purchaser was supplied with four packets from the box, all of which were similar in size, outward appearance, and label, and paid fourpence for them; he then emptied the contents of the four packets into one heap, and divided the whole quantity into three parts, sealed them up, and dealt with them in the usual manner. It was *Held* that each packet was not a separate article for the purposes of the Act, and that the mode in which the contents of the packets were dealt with by the purchaser was a sufficient compliance with the requirements of S. 14 of the Act.

In the course of his judgment ALVERSTONE, C.J., said —"Here the appellant asked for cream of tartar, which, as he saw, was put up in penny packets for the purpose of measurement; he said that he would take four penny packets, and I cannot say that, because four packets of the same article similarly labelled were bought at the same time as cream of tartar, and then mixed together and divided for the

purposes of analysis, the mixing of them together was a good objection to the proceedings subsequently taken upon the analyst's certificate. The case of *Mason v. Cowdary* was cited to us as an authority in favour of the respondent, but that decision is clearly distinguishable, as the facts were by no means the same as those in the present case."

Each of the three portions must be sufficiently large to admit of a proper analysis being made.— In *Lowery v. Hallard*, 1905, 1 K.B., 398, it was *Held* that where an article of food is purchased for the purpose of analysis under S. 14 of the Sale of Food and Drugs Act, 1875, each of the three portions into which the article is required by that section to be divided, must be sufficient to admit of a proper analysis being made of that part. The facts of the case are made sufficiently clear by the following excerpts from the judgment of ALVERSTONE, C. J.—"In this case half a pint of brandy was purchased from the appellant by the respondent, who divided it into three parts; five ounces were sent to the public analyst; three ounces were retained for comparison; and about two, but less than two and half ounces were given to the seller. . . . . It is contended for the respondent that it is not a condition precedent that the other two parts shall be of equal value for the purpose of analysis as the part which is submitted to the public analyst. In my opinion the provisions of S. 14 are conclusive against that contention. . . .

Then S. 21 says that at the hearing the part retained by the purchaser shall be produced; and S. 22, as amended by S. 21 of the Act of 1899, provides that the justices before whom the complaint is made shall at the request of either party, or without such request if they think fit cause the article—that is, the portion retained by the purchaser, and produced in court—to be sent for analysis to the Commissioners of Inland Revenue. Either party, therefore, has an absolute right to have that analysis. . . . . I have, therefore, come to the conclusion, not that the three parts into which the article is divided must be mathematically equal or identical in every respect, but that each part must at least be sufficient for the subsequent purposes contemplated by the statute, that is, for analysis by a Government analyst or by an analyst on behalf of the seller. It is really not disputed in this case that two of the parts did not fulfil that purpose; the part given to the seller, and the part retained for comparison were not sufficient for the purpose of analysis. I entertain no doubt that in order to found a prosecution, the person purchasing an article with a view to analysis must so divide the article that each of the three parts may be sufficient for analysis."

Decisions as to the reserved portion of the sample.—By the Act of 1899 the justices are bound at the request of either party to cause the reserved portion of the sample to be sent to the Government authorities for analysis. But in order that there may

be a conviction, it is not necessary that this reserved portion of the article is intact, or in a fit state for analysis, when sent to Somerset House for that purpose. But if this third portion be altogether lost and not in existence, when its analysis is requested at the time of the trial, so that it cannot be sent to Somerset House at all, there can be no conviction.

Suckling v. Parker, 1906, 1, K.B., 527, was a case in which, after the division of a sample of milk into three parts, the respective bottles were corked, but the corks were not secured by string or other ligature. The production of the third sample was required in Court, when it was found that part of the contents of the bottle had escaped. The solicitor for the defence requested that the bottle be sent to the Commissioners of Inland Revenue for analysis. The Commissioners wrote stating that portions of fat and dried milk were adhering to the outside of the bottle and the paper wrapper, and that a satisfactory examination of the milk was not possible. The magistrate convicted and the defendant appealed. In the course of his judgment on the appeal, Ridley, J., said, "The main point taken on behalf of the appellant is that it was a condition precedent to a conviction that the part of the article retained by the purchaser must be produced at the hearing in a condition capable of analysis, and that that part should in fact have been analysed at Somerset House, and that, those conditions not having been fulfilled, the conviction is bad. In support of that

contention reliance is placed on the case of *Hutchison v. Stevenson* (4, F., J.C., 69). In the case quoted it appeared that a bottle containing the third portion of the article purchased had burst some days before the hearing. . . . . In that case the LORD JUSTICE CLERK said, 'The statute further enacts that if the accused so desires it he is entitled to have this third sample sent to Somerset House for analysis by the Government analyst there, so that his analysis may be produced in evidence at the trial. That in this case became impossible, because the third sample, which was retained by the purchaser, had ceased to exist before the trial.' True; but in the present case the third sample had not ceased to exist. . . . . I cannot find that the Act anywhere says that an analysis of the third sample by the Somerset House authorities is a condition precedent to a conviction. . . . . *Lowery v. Hallard* does not, in my opinion, touch the point with which we are dealing here. In that case . . . . all that was decided was that . . . . each sample must be of a size sufficient for analysis." It was therefore *Held* that it was not a condition precedent to a conviction that the retained sample should have been analysed.

It is difficult to reconcile this case with those of *Hutchison v. Stevenson* and *Lowery v. Hallard.* In dealing with the former case the learned judge distinguished the two by pointing out that in *Hutchison v. Stevenson* the third sample had ceased to exist before the trial, but that in the present case it had not ceased to exist. It is very respectfully submitted, that when

some of the contents of the bottle had escaped, it could not be said that the sample was still in existence. At most, a portion only still existed, and a portion of a sample is not *the sample*, especially when the Somerset House authorities write that a satisfactory examination of the milk from that portion is not possible. In *Lowery v. Hallard*, ALVERSTONE, C.J., regarded it as a condition precedent that the other two parts should be of equal value for the purpose of analysis as the part which is submitted to the public analyst. He further says that "either party, therefore, has an absolute right to have the analysis" of the third part by the commissioners of Inland Revenue. These conditions had not been fulfilled in the case of *Suckling v. Parker*.

Assistance in Making Analysis.—Having received his portion of the article, the public analyst proceeds to make his analysis. For this purpose he may avail himself of the aid of assistants, but should be able to speak from personal knowledge of the material operations of the analysis. In *Bakewell v. Davis*, 1, Q.B.D., 296 (1894), at the hearing of the case, the public analyst stated that the analysis was carried out under his supervision; that he was not present during the progress of some of the processes, but that the weighing of the parts and other material operations had been done by him or in his presence. One of the questions submitted in the case to the High Court was—"Was the analysis properly and legally made by the public analyst within the meaning of the Sale of Food and

Drugs Act, 1875?" The judges did not require this point to be argued before them, and answered it, in effect, in the affirmative.

Form of Certificate.—The following are the provisions relating thereto in the Sale of Food and Drugs Act, 1875:—

18. The certificate of the analysis shall be in the form set forth in the schedule hereto, or to the like effect.

FORM OF CERTIFICATE.

To*

I, the undersigned, public analyst for the do hereby certify that I received on the day of 18 , from† , a sample of for analysis (which then weighed‡), and have analysed the same, and declare the result of my analysis to be as follows:—

I am of opinion that the same is a sample of genuine

or,

I am of opinion that the said sample contained the parts as under, or the per-centages of foreign ingredients as under.

Observations.§

As witness my hand this day of

A.B.,

at

Here insert the name of the person submitting the article for analysis.

† Here insert the name of the person delivering the sample.

‡ When the article cannot be conveniently weighed, this passage may be erased, or the blank may be left unfilled.

§ Here the analyst may insert at his discretion his opinion as to whether the mixture (if any) was for the purpose of rendering the article portable or palatable, or of preserving it, or of improving the appearance, or was unavoidable, and may state whether in excess of what is ordinary, or otherwise, and whether the ingredients or materials mixed are or are not injurious to health.

In the case of a certificate regarding milk, butter, or any article liable to decomposition, the analyst shall specially report whether any change had taken place in the constitution of the article that would interfere with the analysis.

Certificate as Evidence.—According to the Act of 1875:—

S. 21. At the hearing of the information in such proceeding the production of the certificate of the analyst shall be sufficient evidence of the facts therein stated, unless the defendant shall require that the analyst shall be called as a witness, and the parts of the articles retained by the person who purchased the article shall be produced, and the defendant may, if he think fit, tender himself and his wife to be examined on his behalf, and he or she shall, if he so desire, be examined accordingly.

The law has been modified by the Act of 1899:—

S. 19.—s.s. (2). In any prosecution under the Sale of Food and Drugs Acts the summons shall state particulars of the offence or offences alleged, and also the name of the prosecutor, and shall not be made returnable in less time than fourteen days from the day on which it is served, and there must be served therewith a copy of any analyst's certificate obtained on behalf of the prosecutor.

S. 22.—(1). At the hearing of the information in any proceeding under the Sale of Food and Drugs Acts, the production by the defendant of a certificate of analysis by a public analyst in the form prescribed in section eighteen of the Sale of Food and Drugs Act, 1875, shall be sufficient evidence of the facts therein stated, unless the prosecutor requires that the analyst be called as a witness.

(2). A copy of every such certificate shall be sent to the prosecutor at least three clear days before the return day, and if it be not so sent the court may, it it thinks fit, adjourn the hearing on such terms as may seem proper.

Particulars necessary in Certificate.—Very strong opinions have been expressed by analysts as to what data shall be furnished in the certificate. Thus Hehner on certificates, *Analyst*, XVIII., 291.—"He had for some time past made it a rule to omit in every case giving in his certificates any semblance of an analytical figure. . . . . The analytical figures were simply the means to satisfy himself, and to assist him in

forming his opinion. It seemed preposterous that a bench of persons not scientifically educated should be allowed to judge of analytical figures at all. . . . . If he were asked to give his reasons in court, then he would be bound to give them, and also his figures, and he would be glad enough to do so, because he would know more about the figures than anybody who might be in court could know."

ILLUSTRATIVE CASES.

The following are some of the more important legal decisions on the form of certificate and the data required to be given. The figures in brackets (1) refer to notes at the end of each case.

Newby v. Sims. 1894, 1, Q.B.D., 478. In the case of *a sale of rum, the sample was sent for analysis;* the analyst's certificate ran:—

"The Sale of Food and Drugs Act, 1875. . . . . I find that the sample contained an excess of water over and above what is allowed by Act of Parliament. I estimate the excess of water at 13 per cent. of the entire sample. I am of the opinion that the sample is not a sample of genuine rum." The justices were of opinion that the certificate in the above form whereby the public analyst purported to "estimate" the excess of water at 13 per cent. of the entire sample, although in other parts of the same certificate he used the words "I find" and "I am of opinion," was not sufficient evidence of the offence charged to justify them in

convicting the respondent, and accordingly dismissed the information.

In the course of his judgment on hearing the appeal, DAY, J., said "In the present case the statute allows the certificate to be used as evidence. If the respondent had availed himself of his right to require the analyst to be called as a witness, possibly the defect in the evidence would have been supplied; but as he did not require the analyst to be called, the certificate is the only evidence in the case. (1). I am of opinion that on the face of the certificate no offence is proved. The certificate is entitled 'The Sale of Food and Drugs Act, 1875,' and contains no reference to the Act of 1879, and there is no evidence that the analyst ever knew of this latter Act, or that he acted under it or had it before him. (2). . . . I am of opinion that this certificate is defective, but not upon the ground that the analyst states in it that he estimates the quantity of water, for that, in my opinion, is an appropriate word to express the result of his calculation. He states that he 'finds,' that he 'estimates,' and that he 'is of opinion,' and I can see no objection to any one of those expressions. (3). . . . To enable us to act on the certificate we must know what the analyst finds in fact The statement as to an excess of 13 per cent. is quite insufficient, for there is no statement above what amount in fact the excess is. The analyst ought to determine as a matter of fact how much water there is in the pint of rum, (4), and, as he has not done so, the certificate is not in such a form as to

amount to evidence on which the magistrates could act."

LAWRANCE, J.—"The certificate should contain evidence, and not only the conclusion at which the analyst arrived" (5).

Held, The Justices rightly dismissed the case.

(1) This illustrates the principle that it is not always well for the defendant to call the public analyst for purposes of cross-examination. By so doing he may be enabling the prosecution to remedy an otherwise fatal defect in their case.

(2) This particular certificate had as a heading the words "The Sale of Food and Drugs Act, 1875." The previously given "Form of Certificate" does not prescribe any such heading, and it may therefore be regarded as unnecessary. But if any heading is adopted, it should read "The Sale of Food and Drugs Acts, 1875-1899," or whatever may be the dates of the earliest and latest Acts.

(3) The use of the word "estimate" here receives sanction. Although in popular phraseology "estimate" is a more indefinite term than "find," the chemist now usually applies the words "estimation" or "determination" equally and indifferently to his exact finding by operations of analysis.

(4) Here there is a very strong insistence on the rule that analytic data must be furnished. As a fact, the analyst should have stated how much proof-spirit, and how much water there were present.

(5). LAWRANCE, J., insists on the same point, he wants

the evidence, and not merely the opinion which the analyst has formed. On this ground of insufficiency of evidence, the Court held that the dismissal of the case was right.

Fortune v. Hanson, 1896, 1, Q.B., 202. A certificate of analysis of a sample of milk declared the result of analysis to be as follows:—"I am of opinion that the said sample contained the percentage of foreign ingredients as under:—5 per cent. of added water to the prejudice of the purchaser." On hearing the case, the magistrates dismissed the information.

From their decision there was an appeal, and in the course of his judgment, HAWKINS, J., said, "I am of opinion that the certificate was insufficient for the purpose for which it was given. Admittedly there must be a certain percentage of water in all milk, because water is one of the constituents of milk. I think that the Legislature meant that the certificate must state such facts as would enable the magistrates themselves to come to a conclusion, whether the article of food in question had, or had not, been adulterated. (1). If the analyst found in the milk some material substance which could not or ought not to be found in milk at all, it would be sufficient for the certificate to state that the sample of milk submitted to him contained so much percentage of foreign ingredients; but when the magistrates have to decide whether the sample contained 5 per cent. of added water, the question becomes much more difficult, because water is to be found in milk in its most pure

state. . . . . I think the magistrates are entitled to inquire, and the Legislature intended they should have a statement, in such a case as this, of the parts of which the sample was composed. (2). To say merely that a sample of milk contained 5 per cent. of added water is only to state the analyst's own opinion that water has been added. The magistrates have to exercise their own judgment on the question. They may adopt one standard, the analyst another. (3). They ought to be informed by the certificate what was the total percentage of water found in the sample. It is not enough for the analyst to say, "I say that 5 per cent. of water has been added."

KENNEDY, J., "I think that the certificate to be a good certificate, must give data upon which the magistrate can act without further evidence. . . . . It is not sufficient to say, as the analyst here has said in effect, "I come to the conclusion that the sample of milk submitted to me is not genuine because it contains so much added water." (4). The Legislature intended that the certificate should go much further than that, and give the magistrates information which enables them to come to a conclusion themselves, (5). and enables the person charged to understand and, if possible, negative the charge. (6).

Judgment for respondent (original defendant).

Referring back to note (1) on the preceeding case, the point also arose during the present one. Macmorran in presenting the case for the appellant submitted that no hardship could be done to the

defendant by admitting the certificate, because he was entitled if he desired to question it, to require that the analyst should be called as a witness, and to have his conclusion tested by cross-examination. Obviously, if the certificate were on the face of it bad, it would, as a matter of policy on the part of the defence, be extremely foolish for them to afford the prosecution an opportunity of remedying the certificate by putting the analyst in the box.

(1). The facts are to be given by the analyst, but the magistrates themselves must come to a conclusion as to whether or not there had been adulteration.

(2). The judge draws a distinction between the presence of some foreign body, and an adulterant which is also present in some amount as a normal constituent. In the case of a foreign ingredient, it is sufficient to give the percentage. But when the added substance, as water in this case, is common both to the natural article and the adulterant, the actual composition by analysis (parts of which composed), must be given.

(3). Five per cent. of added water is only an opinion, based on the analyst's standard for pure milk. The magistrates may see fit to adopt another standard.

(4). KENNEDY, J., also emphasises the point that it is not sufficient for the analyst to give his conclusions.

(5). The magistrates must have information by which they themselves can arrive at a conclusion.

(6). This is one of the most important reasons why full data should be given in the certificate. The

person charged should have such information as will enable him to negative such charge if he has a good defence.

As to what are sufficient particulars, see

Bridge v. Howard, 1897, 1, Q.B., 80. The certificate of analysis stated that the milk "contains the parts as under:—

Milk, 94 per cent.
Added water, 6 per cent.

This opinion is based on the fact that the sample contained 7·97 per cent. of solids not fat, whereas genuine milk contains not less than 8·5 per cent. solids not fat." The following are extracts from the judgments:—

GRANTHAM, J.—"In this case the analyst has come to the conclusion that water has been added to the milk, and he goes on to state how he arrived at that conclusion. He says that the milk contains a less proportion of solids, other than fat, than genuine milk ought to do, and therefore he is of opinion that water has been added to the milk."

KENNEDY, J.—"Although I still think that the fairest course would be for the analyst to state in his certificate the parts contained in the sample (1), he is no doubt permitted by the form of the certificate given in the schedule to the Act to set out the percentages of foreign ingredients contained in the sample. What he has done here has been not only to state the percentage of "added water," but also to give the scientific basis on which his conclusion rests. . . . I am of opinion that there has been a sufficient compliance with the Act."

(1) Kennedy, J., thinks it the fairest course to state the parts contained in the sample. Of this there can be no doubt. No word is mentioned in the certificate as to the percentage of fat in the sample. A milk with 8·5 per cent. of solids not fat and 3·0 per cent. of fat would be passed as pure. But if, for example, the milkman take a milk containing 8·5 per cent. of solids not fat and 4·30 per cent. of fat, and dilutes it to 94 per cent. of milk and 6 per cent. of water, the composition will then be 7·97 per cent. of solids not fat and 4·04 per cent. of fat. Undoubtedly such tampering with milk is an adulteration; but still the fact remains that the adulterated milk with 7·97 per cent. of solids not fat might have contained, on the above assumption, 4·04 per cent. of fat, and would in that case be intrinsically worth to the consumer a third as much again as is the "pure" milk with 8·5 and 3·0 per cent. of non-fatty and fatty solids respectively. The "fairest course" would be, whether it told for or against the vendor, to let this be perfectly clear in the certificate of analysis.

It was decided in the case of *Banks v. Wooler* (page 31), already referred to, that even though there has been an addition of water, if after such addition the milk is still exceptionally good, the justices are entitled to consider whether or not the offence is too trifling to convict. In view of this decision it becomes of great importance that the certificate of analysis should fully state the parts contained in the sample.

Although decided earlier than *Bridge v. Howard*, the following case may be appropriately considered here.

In *Bakewell v. Davis*, 1894, 1 Q.B. 296, which in point of time just preceded *Newby v. Sims*, the offence alleged was that of abstraction of fat from milk. The judgment, of which the following is an extract, sufficiently states the facts. CHARLES, J., says—"The certificate . . . states the result of the analysis in these words: 'twenty-two per cent. of fat less than natural;' then under the heading 'observations' comes a statement that the abstraction of fat is a fraud, and may possibly be injurious to health. Upon carefully considering the form of certificate given in the schedule, I notice that the 'observations' are only to be made when the case is one of adulteration, and that they are not to be made in such a case as the present, where adulteration is not suggested (1). . . . I come now to the other point—whether this certificate is in accordance with the form in the schedule. I think that it is. The second alternative—that is, percentages of foreign ingredients—is clearly applicable only to cases of adulteration. . . . In my judgment it would be to apply the first alternative in the certificate—that is, the words 'parts as under'—to a wrong subject-matter, if we are to suppose that the analyst must set out the parts of the sample analysed where the case is not one of adulteration, but falls short of it, . . . the present certificate seems to be good. It reports accurately the result of the analysis. . . . It is not intended that the Court should consider how the result is arrived at: the result itself is the important factor (2).

The certificate was upheld.

(1) In cases of abstraction, where the addition of foreign matter is not alleged, in the judge's opinion "observations" are not to be made. The objectionable observation is that the "abstraction of fat is a fraud." Whether an act alleged is a fraud is for the Court to decide and not for a witness.

(2) There is no radical difference in the chemical principles involved in saying that there is "twenty-two per cent. of fat less than natural" and in saying as in *Fortune v. Hanson*, "5 per cent. of added water" is present. Both statements are based on comparing actual results with a standard adopted by the analyst. In the present case the judge was of opinion that the Court was not concerned in how the results were arrived at, but only with the result itself. The later exposition of the law in both *Newby v. Sims* and *Fortune v. Hanson* is, however, very decidedly in favour of a full disclosure of the results of the analysis.

From the legal decisions, it is quite clear that there must be no policy of concealment, but that all necessary figures must be given.

Articles liable to Decomposition.—In these cases the analyst is required to specially report in his certificate whether or not any change has taken place in the article that would interfere with the analysis. The case of *Hudson v. Bridge, Analyst*, XXVIII., 165, was a prosecution for the sale of vinegar of squills of insufficient strength. In the course of his judgment on the Appeal, the L.C.J. said—

"In the case of a certificate regarding milk, butter, or any article liable to decomposition, the analyst shall specially report whether any change has taken place in the composition of the article which would interfere with the analysis. This certificate said nothing about the article being liable to decomposition, and contained no statement that a change had taken place which would interfere with the analysis." In all such cases the analyst ought to comply with the directions of the Act.

Wills, J., was very strong on the same point. "The certificate of the analyst was made a condition precedent to any prosecution, and it ought to be properly certified."

Meaning of "prima facie" evidence.—By the 1899 Act a copy of the certificate must be served on the defendant with the summons. The *side note* to S. 21, 1875, reads "Certificate of analysis *prima facie* evidence for the prosecution." "*Prima facie*" and "sufficient" evidence do not mean conclusive evidence. Where there is no rebutting evidence for the defence, the certificate is sufficient evidence on which to convict. (*Harrison v. Richards*, 45, J.P. 44.)

Hewitt v. Taylor, 1, Q.B., 287. The facts of this case are sufficiently set out in the judgment by Lindley, L.J.—"The respondent was summoned by the appellant for selling milk which was alleged to be adulterated, and in support of the charge a certificate from the public analyst was produced which was to

the effect that upwards of six parts of water had been added to every hundred parts of the poorest milk. The respondent appeared, and although he did not require that the analyst should be called as a witness, he gave evidence himself on his own behalf, which was to the effect that no water had been added to the milk. The justices were satisfied with his evidence, and refused to convict him. It is now contended that they were bound to do so, and it is said that if the analyst is not called as a witness, and if proceedings are not taken under S. 22 for a further analysis of the food or drugs in question, the certificate of the analyst is conclusive, and no evidence given by the respondent can save him from conviction. The section, no doubt, says that the certificate of the analyst shall be "sufficient" evidence, and, consequently, if no evidence were adduced by the defendant, the justices would be right in convicting upon it without requiring anything further. But that the certificate is not conclusive is clear from the rest of the section. . . . . The ambiguity in the word "sufficient" is thus removed. It is sufficient only when there is no evidence to the contrary. If, however, there is evidence to the contrary, the justices must weigh that evidence and decide on the whole. In the present case, the analyst could only say, as a fact, that there was an undue proportion of water in the milk. That it had been added to the milk could only be a matter of opinion, and it seems to me that the respondent had a right to contradict it."

Notification of Evidence for Defence to Prosecution.—S. 21 of the 1875 Act reads, "Unless the defendant shall require that the analyst shall be called as a witness." The *defendant is entitled* to have the analyst as a witness *if he requires* it. It may be that the defendant believes that he can break down the evidence of the certificate by cross-examination, and, if so, he must be furnished with the opportunity of so doing.

A well-known rule in trials of actions is that the defence must, in cross-examination of the prosecutor's witnesses, foreshadow the case which he himself intends to set up. Does this rule entail that, on a defendant calling evidence to contradict the certificate, it is his duty to so notify the prosecution, and cross-examine the analyst on his, the defendant's, evidence?

Magistrates at times seem rather disposed by their action to answer such a question in the affirmative. In the South Wales Yeast Case, referred to on page 76, the defendant did not require the analyst to be called as a witness, but called a chemist as witness for the defence, who deposed that the added starch was required for the preparation of the yeast as an article of commerce, in a fit state for carriage; and was not fraudulently added to increase the weight, displacing as it did about three-fifths of its own equivalent of water. The magistrate several times interrupted to say that if this evidence were to be given the other side should have been warned, so that they might have called the analyst, to whom these matters should have been put

in cross-examination. The defendant's solicitor argued that it was no part of the duty of the defence to assist the prosecution in getting up their case, that it was the privilege of the defendant in a criminal action to reserve his defence until the trial, and that to have notified the prosecution of an intention to cross-examine the analyst would to that extent have disclosed the defence. It is submitted that this latter view is correct, and that no obligation lies on the defendant to require the analyst to be called, unless it is believed that his cross-examination will be of benefit to the defence. This contention is supported by the judgment of LINDLEY, L.J., in *Hewitt and Taylor*, just quoted. The defendant did not require the analyst to be called as a witness, but gave directly contradictory evidence himself, and the justices believed him. There was no suggestion throughout the whole hearing that the defendant *ought* to have required the presence of the analyst as a witness for purposes of cross-examination as a condition precedent to adducing contradictory evidence for the defence.

The Defendant may put in Certificate.—S. 22, 1899, puts the defendant in the same position as the prosecution in so far as he may put in a certificate of analysis from a public analyst as "sufficient evidence." A copy of the certificate must be sent to the prosecutor at least three clear days before the hearing. This is subject to the same general conditions as that for the prosecution.

Note, the certificate must be that of a *public analyst*. No other chemist of however high standing can give evidence this way, but must be called as a witness.

Precautions by Analyst.—Before dispatch, the public analyst should see that his certificate is perfectly regular. By the form in the schedule (page 211), the certificate must state that the "sample contained the parts as under, or the percentages of foreign ingredients as under." He must also bear in mind the directions as to "observations," and also as to "any article liable to decomposition." The foregoing cases serve to illustrate the meaning attached to these requirements by the Courts.

Precautions by Solicitors.—The solicitor for the *prosecution* should on receipt of the certificate from the analyst see that it is perfectly regular in form. If in any way technically faulty, it should be altered by the analyst, and the fault thus remedied. For example, in the case of a milk alleged to contain added water, without any statement of the percentage of solids not fat; it should be returned for these latter to be inserted by the analyst. It should also be considered whether or not the analyst should be called as a witness, or at least whether he should be in attendance at the hearing for that purpose if thought desirable. This should not be necessarily governed by notice from the defence, but must also depend somewhat on the importance of the case.

If any certificate is received from the defence, this should be submitted to the public analyst for the prosecution, by whom it must be considered, and who should prepare rebutting evidence if necessary.

The solicitor for the *defence* has to decide whether the question is to be fought on its merits. If so, he should submit the prosecution's certificate to some chemist, either a public analyst or some other person. It is sometimes thought an advantage to obtain the services of another public analyst, since his certificate in itself can be put in as evidence. It is very rarely, however, that a contested case will be satisfactorily decided on certificates only. It may, therefore, be taken for granted that the personal presence of the chemist as a witness will be necessary, and so the advantage of his also being a public analyst is somewhat illusory. It is well to remember that most of a public analyst's work is done for the prosecution, and, therefore, if he appears for the defence it is more than likely that he may be considerably hampered, and his evidence seriously weakened by views he has previously expressed on the same or allied subjects. If on the other hand a public analyst feels very strongly in a particular case that the position of the prosecution is a mistaken one, then the fact of the chemist being a public analyst will in all probability add to the weight of his evidence. In any event, the chemist selected should be one whose authority will carry weight in the special matter in dispute. It should

be considered whether the accuracy of the prosecution analysis can be successfully impugned. Even if the analysis is correct, has the alleged offence been committed? *e.g.*, Is a mixed colour injurious to health? Is some matter present in the article required for its production or preparation? Evidence must be prepared on these or similar points, and the defence must be ready at the hearing with the necessary witnesses.

Reference to Somerset House.—This was discretionary under the 1875 Act:—

> "S. 22.—The justices before whom any complaint may be made, or the court before whom any appeal may be heard, under this Act may, upon the request of either party, in their discretion cause any article of food or drug to be sent to the Commissioners of Inland Revenue, who shall thereupon direct the chemical officers of their department at Somerset House to make the analysis, and give a certificate to such justices of the result of the analysis; and the expense of such analysis shall be paid by the complainant or the defendant as the justices may by order direct."

It was, however, made obligatory by the Act of 1899:—

> "S. 21.—The justices or court referred to in section twenty-two of the Sale of Food and Drugs Act, 1875, shall on the request of either party under that section cause an article of food or drug to be sent to

the Commissioners of Inland Revenue for analysis, and may, if they think fit, do so without any such request."

The justices are now compelled to send the article to Somerset House for analysis, at the request of either party, and are empowered to do so on their own initiative.

The Somerset House attitude has always been most impartial and judicial as to the functions exercised by them; they are, so far as chemical facts are concerned, in the position of a referee or court of appeal. In the interests of justice nothing could be more strongly deplored than that there should ever be any reason to suppose that "they would do all in their power to uphold the analyst's certificate."

The Somerset House certificate is not conclusive on the justices. But it is difficult for the party demanding a reference to Somerset House to contest its decision, which is almost certain to determine the judgment of the justices. Even the party not demanding such reference will find an adverse decision in most cases fatal. In particular, there is very little likelihood in any case of the prosecution succeeding against such adverse decision. The defence has rather a better chance. They may call rebutting evidence of a number of chemists of the highest authority, and thus influence the justices. This is usually more easily done on matters of opinion, *e.g.*, injurious to health, than on the accuracy of the analysis. Authentic

samples will probably at this time have been used up. Care should be taken by the analysts on both sides to preserve the remainders of their samples for further analysis if necessary.

Defence of Warranty.—By section 25 of the Act of 1875, it is provided that:—

> "If the defendant in any prosecution under this Act prove to the satisfaction of the justices or court that he had purchased the article in question as the same in nature, substance, and quality as that demanded of him by the prosecutor, and with a written warranty to that effect, that he had no reason to believe at the time when he sold it that the article was otherwise, and that he sold it in the same state as when he purchased it he shall be discharged from the prosecution, but shall be liable to pay costs incurred by the prosecutor, unless he shall have given due notice to him that he will rely on the above defence."

In most cases where a warranty is pleaded as a defence, points of chemical interest do not arise; but *Hennen v. Long*, 1904, 68, J.P., 237, is of importance in this direction. The respondent was summoned for selling milk which was alleged to be adulterated. The respondent relied on a warranty under which he bought the milk, but admitted that he had added one ounce of milk preservative to each ten gallons of milk. It was *Held* that the respondent could not rely on the

warranty as a defence, as he had not sold the milk "in the same state as when purchased."

Presumably, any other addition, such as the addition of even the tenth of an ounce of colouring matter, would also serve to take the milk out of the protection of the warranty. The question is not whether the thing added or substracted has done any harm or not, but that which is sold must be exactly what was purchased.

Appeals.—If the case is lost on questions of fact, the appeal should be to Quarter Sessions. Both appellant and respondent should consider all questions of chemical evidence in the light of the cases for the prosecution and defence as presented before the justices. Any additional evidence necessary to strengthen the weak points should be prepared, and each side must be ready with all the materials requisite for a new hearing of the whole case.

If the case is lost on questions of law, an application is made for a case to be stated for the Divisional Court. Examples of such appeals when chemical matters are in issue, are contained in foregoing cases.

More General Criminal Cases.

Prosecuting Solicitor.—All preliminary threads will be in the hands of the prosecuting solicitor. He will take steps to ascertain what chemist or chemists are experts in the particular branch of chemistry concerned. In some instances he may have to deal

with the official analyst of the Home Office or others holding recognised appointments. He will arrange for formal proof of the handing over to the chemist selected of all articles required to be analysed. It is important that he should see that all *chemico-legal* problems are fully put to the chemist, *e.g.*, in the case of administration of a noxious thing, was the actual quantity noxious or innoxious? The report from the chemist will be followed by a consultation at which the question should be discussed as to whether there is sufficient chemical evidence for a *prima facie* case.

Defending Solicitor.—Meanwhile the suspected person may very possibly have been arrested. If possible, he will have taken legal advice. The defendant's solicitor, knowing the nature of the charge, must consider the possible lines of defence on chemical matters. There is no use in applying for the presence of a chemist, as representing the defendant, at the analysis by the prosecution chemist, as this is now invariably refused. The defendant may possibly be able to dispute the facts as to poison or he may allege innocent administration. Unless the case for the defence is exceptionally strong, it is probably better to reserve the defence before the magistrates. This is justified by the fact that much chemical work may be involved in preparing it. The case for the prosecution is now known to the defendant through the hearing and depositions. It must be considered

again, what chemical evidence is necessary, and especially whether there is any requiring analytic or other work to be done between then and the trial.

Advice on Evidence.—It is one of the special functions of counsel to advise on evidence. Where any chemical questions of difficulty are likely to arise, counsel should be instructed to so advise at an early stage, and ample opportunities of consultation with chemists should be arranged.

Civil Cases.

Though the issues are not so vital as in criminal matters, yet the problems arising are frequently more complicated.

Solicitors.—The solicitors for the plaintiff will in such cases (assuming the matter to be of sufficient importance), have taken both chemist's and counsel's opinion before the issue of the writ. It is well to have these acting together even at this early stage. On service of the writ the defendant's solicitors will take corresponding steps for the defendant. In all probability the defendant will be quite familiar with the points in issue.

The Pleadings will show the exact nature of the case for both parties.

Advice on Evidence.—This should follow as speedily as possible. Counsel will indicate the chemical

evidence necessary to prove his case. The chemist in return should clearly state whether or not the chemical evidence will be strong enough to prove the case wished to be made out. When necessary, *at this stage*, counsel and chemist should together review the whole position. On weak points, further chemical investigation should be made, the chemist must satisfy himself that he has exhausted all means of proving the case submitted to him. Experiments should be continued until this point is reached. Counsel will then determine whether sufficient proof is available, and will take care that his case is put no higher than can be borne out by the evidence. It must be borne in mind that technical cases are often lost or won before the trial of the action. Time is of the utmost importance. Chemical evidence cannot be prepared in a hurry. Therefore, its preparation must be started at the earliest possible moment. For its adequate preparation chemist and counsel should act conjointly, and therefore be instructed accordingly.

Case for opposite side.—It is necessary to consider all possible forms of attack, and provide evidence to deal with any such contingencies as may arise.

Patent Cases.—The results of search as to anticipations, state of the art, alleged infringements, etc., should all be laid before the chemist; their bearing must be carefully considered by him. These mixed questions of law and fact should be conjointly

examined, and the course of action decided on at as early a stage as possible, so as to allow time for chemical research.

"Proof" of Chemical Witness.—He should first state his *qualifications*. He must take care to show that these include expert knowledge, and working experience of the matter in question. *Limitations.*—These are not so frequently stated, yet they are of the utmost importance, *e.g.*, a young chemist may say, "I made certain analyses, to do this I am perfectly competent; but I do not lay claim to be able to speak with authority on the theories involved in the point at issue." Even a distinguished specialist may similarly disclaim special knowledge outside his own particular department of work. Such disclaimer is a guide to counsel, who will then not take the witness over subjects on which he is unable to speak with authority.

The *judge and jury are not chemists*. Therefore all evidence must be set out in as non-technical language as possible. Where technical terms are necessary, clear explanations of them must be given. As far as possible all statements should be arranged in chronological order. *Step by step*, all evidence necessary for direct proof of the point requiring to be proved must be furnished. No link in the chain must be missing. Special care must be taken that there is *legal proof*, of every step, *e.g.*, *Book proof must not be relied on*. For instance, having proved by analysis that a certain substance is sodium sulphate, the

chemist must not rely on the authority of any book, however eminent its author may be, for a statement of the substance's properties. These must be of one's own knowledge, and the witness must if necessary ascertain and test the point for hearing. Still, the witnesses' *general* knowledge is admissible, even though derived from book study; but on a point of any importance, special knowledge, the result of actual experiments *ad hoc*, is infinitely more valuable.

In addition to direct evidence there must be set out such matters as may be necessary to deal with the objections, arguments, and case generally of the other side, so far as they can be anticipated.

It is well to point out where the chemical evidence is weak, and especially where there is anything that may adversely affect the witnesses' own evidence. Thus he may have publicly expressed some opinion apparently contrary to that advanced in his present evidence. If so, the fact should be stated, together with its explanation, such as that the circumstances of the two cases are different, or further researches have caused the witness to change his opinion. The nature of these latter should be indicated.

Before Trial of Action.—The witness should exhaustively go over the "proof" of his evidence, and should assure himself that he thoroughly and accurately remembers the data and facts by which each statement is established. By a careful study of the evidence which he thinks likely to be advanced on the other

side, the chemist should endeavour to anticipate the kind of questions likely to be put to him in cross-examination. He should then decide what is the correct answer to be given to such questions. He may have employed analytical processes, which necessarily have some margin of inaccuracy. Beforehand it should be decided what is the true and proper margin; if the witness decides in his own mind that it is, say, 3 per cent., he should not be cajoled into afterwards admitting that it may be 4 or even 5 per cent., and so on indefinitely. These suggestions are based on the fact that the primary function of the witness in the box is that of giving evidence of previously ascertained facts, and conclusions based thereon. It is not a place for making analytical estimations or working out hypothetical problems.

At Trial of Action.—The chemical witnesses will be present. They must bring all exhibits, &c., carefully and plainly labelled, and in the most convenient form for inspection by the judge, jury, and others.

Witnesses are entitled to refresh their memory by consulting memoranda, made at the time of the occurrence, while in the witness-box. These include *laboratory note-books*; which, therefore, should be brought. But if such note-books be used, the counsel on the opposite side is entitled to see them and use them for purposes of cross-examination. In the case of a number of complicated analyses, by consent of both sides, *prints* may be put in. A sufficient number

of copies should be provided for use of all persons concerned.

Examination in Chief.—Evidence in direct proof will be given as simply and clearly as possible. At times, by permission of the Court, a witness makes chemical experiments or demonstrations in the box. Unless of a very simple character, it may be doubted whether much advantage is thereby gained. It is impossible to take such precautions in the witness-box, as one almost unconsciously takes in the laboratory—the result is such experiments have too frequently a knack of going wrong. For this reason it is far better to depend on a clear description of the nature and result of an experiment, than to court the disaster of a failure in attempting to repeat it before the Court.

Cross Examination.—The following piece of advice to counsel was given by one of the highest technical authorities at the Bar:—"Consider carefully what admissions you desire to get from the witness, direct your questions to them, and, having succeeded in getting what you wish, *stop.*"

Among things for the witness to bear in mind is that, on questions being directed to matters on which he must make an admission, it is by far the best course to at once make the admission frankly. He is, however, entitled to qualify such admission by any necessary explanation.

A favourite form of cross-examining question is

that in which some proposition is laid before the witness, with the request that he shall answer "Yes or No?" The judge will frequently support such a request, and ask the witness to so reply. Obviously, when such an answer is obtainable, the evidence is much simplified. But, if the question does not admit of such an answer, the witness should steadfastly refuse to give it, explaining the reason why.

The witness should regard with caution any questions by which he is asked to form and give an expert opinion in the box itself. He may have stated in his evidence in chief that of two things one is the better. Cross-examining counsel may show him two other similar things, and ask which is the better. Or he may have explained a somewhat abstruse piece of theory, and be asked to solve some other problem of a like nature. When such questions are put, the avowed object is usually to test the knowledge or competence of the witness. But it should always be remembered, not only by others, but by the witness himself, that the majority of persons, whether chemists or skilled workmen, may be quite able to solve correctly a puzzling problem when it presents itself in the ordinary course of their work in the laboratory or workshop, and yet be totally unable to do the same in the witness-box. If such an examination of samples is necessary before an opinion is given, that it cannot be well made in the box, the witness should decline to hazard an opinion until after an opportunity of making a proper examination. If a

In civil actions there is somewhat more latitude. The following remarks are made by Taylor in his work on *Evidence*, S. 1423, p. 1027.—On proof of foreign law, law being a science, "a witness may refresh and confirm his recollection of the law, or assist his own knowledge, by referring to text-books. . . . . And if he describes these works as truly stating the law, they may be read, not as evidence *per se*, but as part and parcel of his testimony."

The following are references to cases:—*Sussex Peerage Case* (C. & F., 114). LORD BROUGHAM, "the witness may refresh his recollection by referring to authorities on the matter of law to which his evidence is addressed."

Collier v. Simpson (5, C. & P., 74, 1831). Sir H. Halford, medical witness said, "he considered the medicine proper, and that it was sanctioned by books of authority."

Counsel objected.

TINDAL, C. J. "I do not think the books themselves can be read; but I do not see any objection to your asking Sir H. Halford his judgment, and the grounds of it, which may be in some degree founded on books as a part of his general knowledge."

These cases do not go quite so far as Taylor, judges will now usually forbid books being read. Whether read or referred to, they are certainly not evidence—to make them so, the author must be called. All the witness can say is, "I know this subject, and from my general knowledge *I say* that such and such a paragraph in the book is a correct statement of fact." In any case

a book *per se*, being the work of a living author, is not evidence, and any reference to standard works for justifying one's personal knowledge may be regarded as a confession of weakness, and lessen the value of the evidence accordingly. If asked "how do you know that?"—The answer, "Because it is in such and such a book," will not do—it does not make the fact evidence. The answer, "I know it as a part of my general knowledge," is sufficient, although the general knowledge is culled in part from the very book in question. The one gives an absent person as authority; the other is a part of the general knowledge which one has *assimilated* and made one's own, and for which the witness in the box makes himself responsible.

Examining counsel may not read a passage from a book, and ask "Do you agree with that? because it would be leading the witness, but

Cross-examining counsel frequently does so. Thus in *R. v. Palmer*, *Times* report, the following occurs:—

Witness being cross-examined by *Sergeant Shee*, "Do you agree with this opinion of Dr. Copeland expressed in his Dictionary of Practical Medicine, under the head General Convulsions. The abnormal contraction, etc.?"

Answer, "I would rather speak from my own observation. I have not observed anything of the kind."

Note.—No objection was taken to the question either by counsel or by the Court.

The matter is frequently put in the following manner:—

Counsel. Do you know this book? (Produced.)

Witness, Yes. (If "no," the matter usually drops).

Counsel. Is M. the author, a high authority?

Witness, Yes. (Unless the witness feels he may deny his authority in general, or on that subject in particular).

Counsel. I will read you a passage. (Reads). Do you agree with that?

Witness (probably). No.

If the matter stops here, the cross-examining counsel has got it before the jury, even though the witness does not agree with it, that M., a high authority, has expressed a decided opinion in favour of his contention, though M. is not present, and very possibly if he were he would have said that the particular passage did not apply to the case then being decided.

If the witness thinks this, he may qualify his answer by saying as much, *i.e.*, "No, nor do I think that would be his view in this particular case."

Witness may very reasonably ask to see the book so as to examine the context. If this is refused, re-examining counsel has the remedy in his hands.

Very recently (November, 1907), ENGLISH HARRISON, as *Commissioner* at the Winchester Assizes, had the point raised before him in a murder case. The prosecution alleged that the prisoner had strangled a woman by compressing her throat with his fingers. The defence was that the injuries were self-inflicted. A medical witness for the prosecution had stated in his evidence in chief that self-strangulation in this way was impossible.

Cross-examining counsel wished to put a paragraph from a medical work of high authority. *(Burghardt's Principles of Surgery.)*

The COMMISSIONER refused to allow counsel to tell the witness the name of the author of the book.

Counsel then read the passage and asked witness whether he agreed with the opinion therein expressed.

The *witness* replied in the negative.

The *Case being over*, and the parties out of Court, the witness was shown the book, and remarked that had he known the author was Burghardt, he would not have committed himself to such a definite answer as he had given.

Objections to such use of Books.—In justification of the Commissioner's decision it may be urged that it is not right to overweight the witness and jury by a book statement, brought in in cross-examination, with all the implied authority of a very eminent man, who might not himself regard the quotation in question as bearing on the case being tried; and whose statement could not be tested in any way by cross-examination.

Example of Ruling in Civil Action.—Since the above was written the following occurred during the hearing of the case of *The Flour Oxidising Coy., Ltd., v. J. & R. Hutchinson* before WARRINGTON, J., on the 26th March, 1909, in one of the Courts of Chancery. Dr. E. F. Ladd, a chemical witness, was being cross-examined by Astbury:—

Astbury. Now I want to ask you this. You have perhaps heard of Dr. Tunnicliffe in this country?

Witness. Yes.

Astbury. He is a very great authority on these digestive matters?

Witness. He is so considered.

Astbury. Now I want to read you a passage in some evidence given by Dr. Tunnicliffe in a Commission in this country.

Cripps. (Counsel on the other side.) Do you call Dr. Tunnicliffe?

Astbury. No.

Cripps. Then you cannot put this in as Dr. Tunnicliffe's opinion unless you call him.

WARRINGTON, J. No, but I suppose you can ask a scientific witness if he agrees with it.

Cripps. Yes, but that is a different matter. My friend introduces this by mentioning a gentleman whose name is a great authority, but he cannot put in his evidence.

WARRINGTON, J. No, but he can test the credit of this witness by asking him whether he agreed.

Cripps. Yes he can read something, and ask him whether he agrees, for what it is worth.

Astbury. I do not ask whether it is Dr. Tunnicliffe's evidence.

Cripps. But you should not mention his name.

Astbury. I beg your pardon, I can say—Is not this a well-known author, and is not this stated in the book?

Cripps. It has been held over and over again that

as regards evidence before a Commission you cannot mention a name. The only object of mentioning a name is to produce it as an authority to state the name. You cannot do that without calling the evidence. [witness].

WARRINGTON, J. I cannot accept any reference to Dr. Tunnicliffe as to his opinion as an authoritative opinion.

(The passage was read, and put to the witness as though it were Counsel's own question).

In this instance, although a civil action, the rule as to exclusion was applied *even more strictly* than in the murder case before cited.

Argument in favour of the use of Books.—On the other hand there is much to be said for the view that some familiarity with an authoritative text-book is a part of a professional man's training. If a passage from such a work, together with the author's name, is put to a witness in cross-examination, he will know quite well what is the reputation and standing of the book. As in all probability the opinion therein expressed is at variance with that advanced by the witness, he is not likely to be unduly influenced by the author's views. If they do not bear on the case in question, and for any reason ought not to be considered to apply, the witness will be well able to point this out. This is one good reason for permitting books to be put in cross-examination, and not in examination in chief. One great advantage of book evidence is that, in the case of

a man of reputation and authority, it will be a carefully considered and absolutely impartial statement of facts and opinions. Whereas, if that same person be called as a witness, he will prepare and give evidence *ad hoc*, addressed to the proof of one particular view or hypothesis. He is thus almost insensibly biassed, and his actual evidence in the box is not likely to be so judicially impartial as his written statements on the same subject.

Use of Books by Counsel.—Counsel, as well as witnesses, are prohibited from using scientific books as authorities for the arguments they advance. The criminal law decisions on this point are very emphatic. Thus in *R. v. Crouch*, [1843], 1, Cox C.C., 94, the prisoner was indicted for the wilful murder of his wife. Clarkson for the defence attempted to quote from a work entitled "Cooper's Surgery," the author's opinions on the subject.

ALDERSON, B., thought he was not justified in doing so.

Clarkson. I quote it, my lord, as embodying the sentiments of one who has studied the subject, and submit that it is admissible in the same way as opinions of scientific men on matters appertaining to foreign law may be given in evidence.

ALDERSON, B. I should not allow you to read a work on foreign law. Any person who was properly conversant with it might be examined, but then he adds his own personal knowledge and experience to the information he may have derived from books. We

must have the evidence of individuals, not their written opinions. We should be inundated with books if we were to hold otherwise.

Clarkson. I shall prove the book to be one of high authority.

ALDERSON, B. But can that mend the matter? You surely cannot contend that you may give the book in evidence, and if not, what right have you to quote from it in your address, and do that indirectly which you would not be permitted to do in the ordinary course? *Held,* Counsel has no right in his address to the jury to quote the opinion of a high authority as given in his published work.

R. v. Robert Taylor. [1874], 13, Cox, C.C., 77. The decision in *R. v. Crouch* was confirmed in *R. v. Taylor.* Counsel for the defence in addressing the jury proposed to read a case from Taylor's "Medical Jurisprudence." BRETT, J.—"That is no evidence in a court of justice. It is a mere statement by a medical man of hearsay facts of cases at which he was in all probability not present. I cannot allow it to be read."

The same ruling is generally given in civil cases, though occasionally counsel is permitted to read a passage from a book not by way of authority, but as "part of his argument."

Conclusion.—The task set himself by the author has now arrived at its close; he trusts that in the foregoing pages he may have succeeded in making clear to the chemist some of the lawyer's requirements

in the matter of chemical evidence. He hopes also that the explanations of the underlying scientific principles of such evidence may prove of service to lawyers who have to handle the same. If this be so, even in some slight degree, the object for which the book was written will have attained fulfilment.

THE END.

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